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UNITED FRUIT COMPANY

General Offices: Boston, Massachusetts

Medical Department

SIXTEENTH
ANNUAL REPORT

1927

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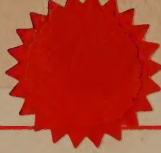


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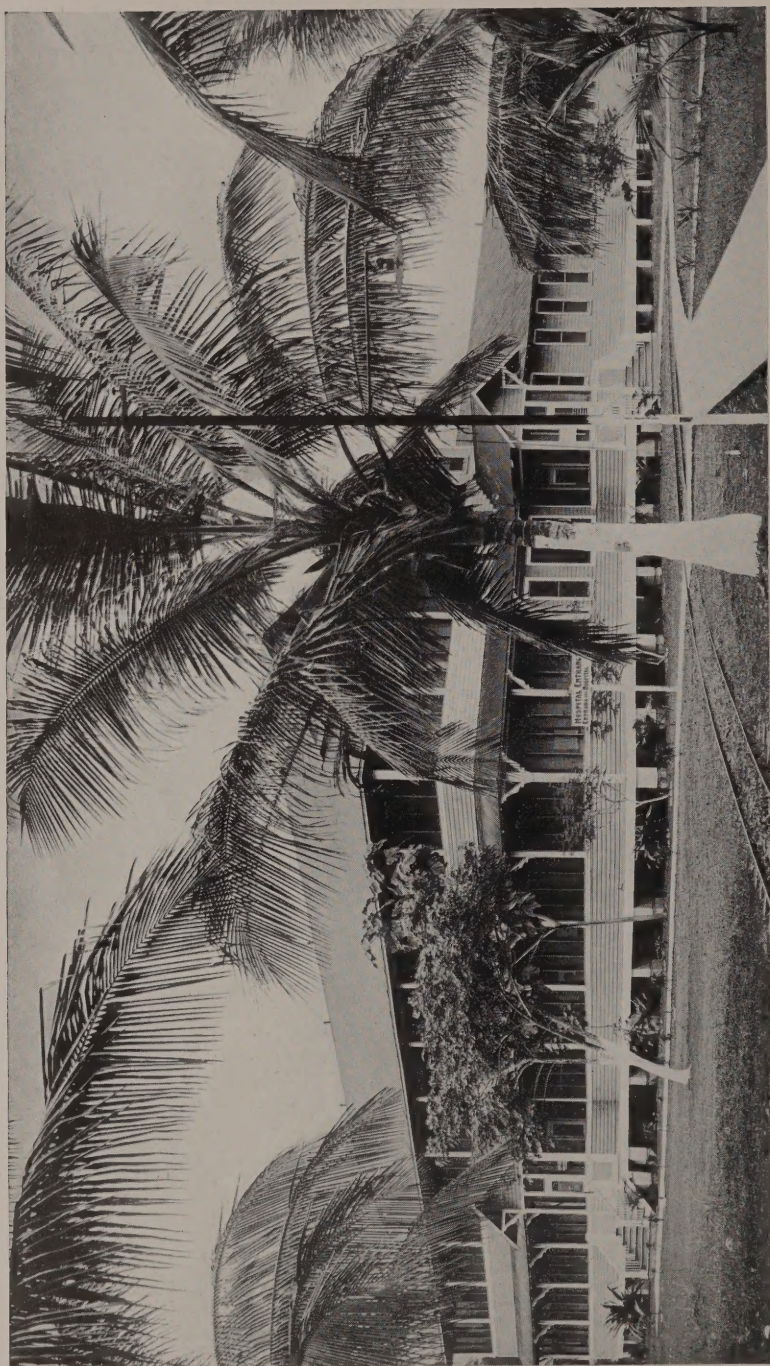


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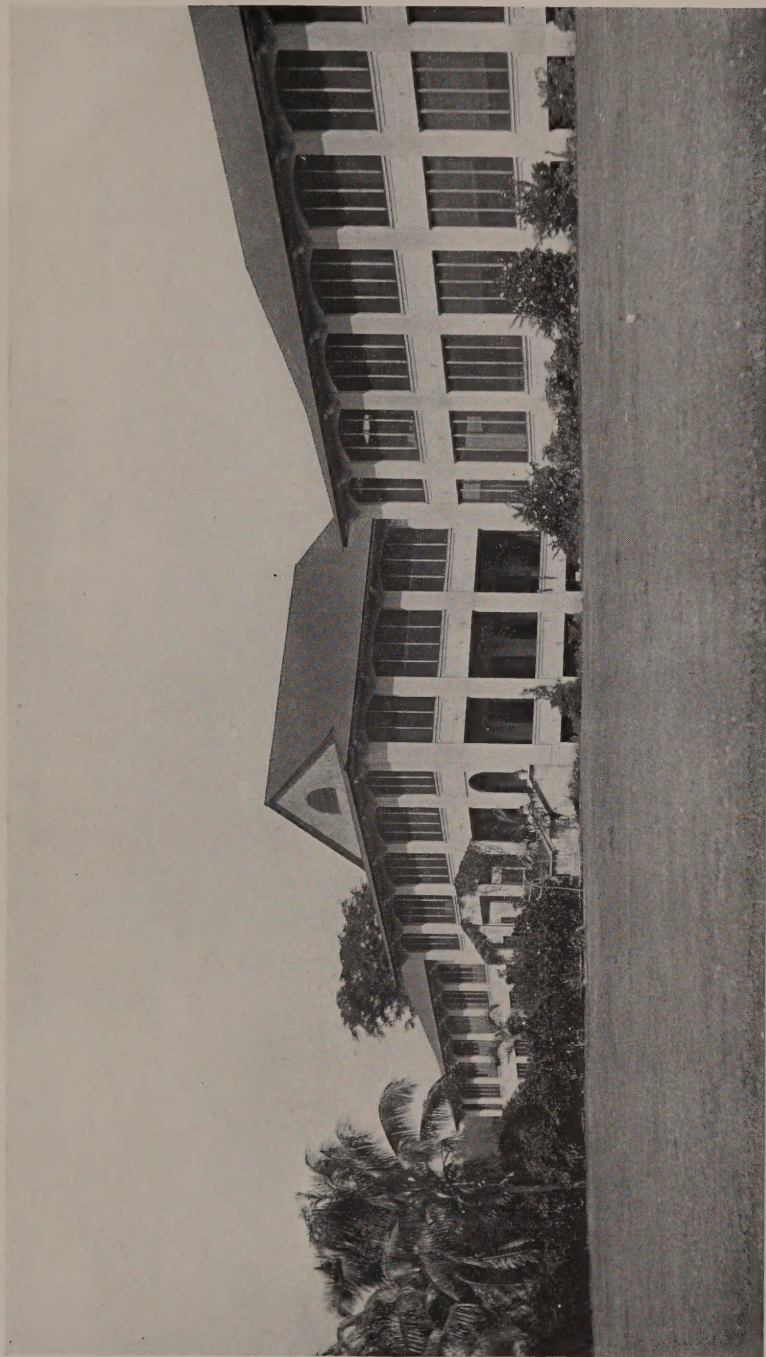
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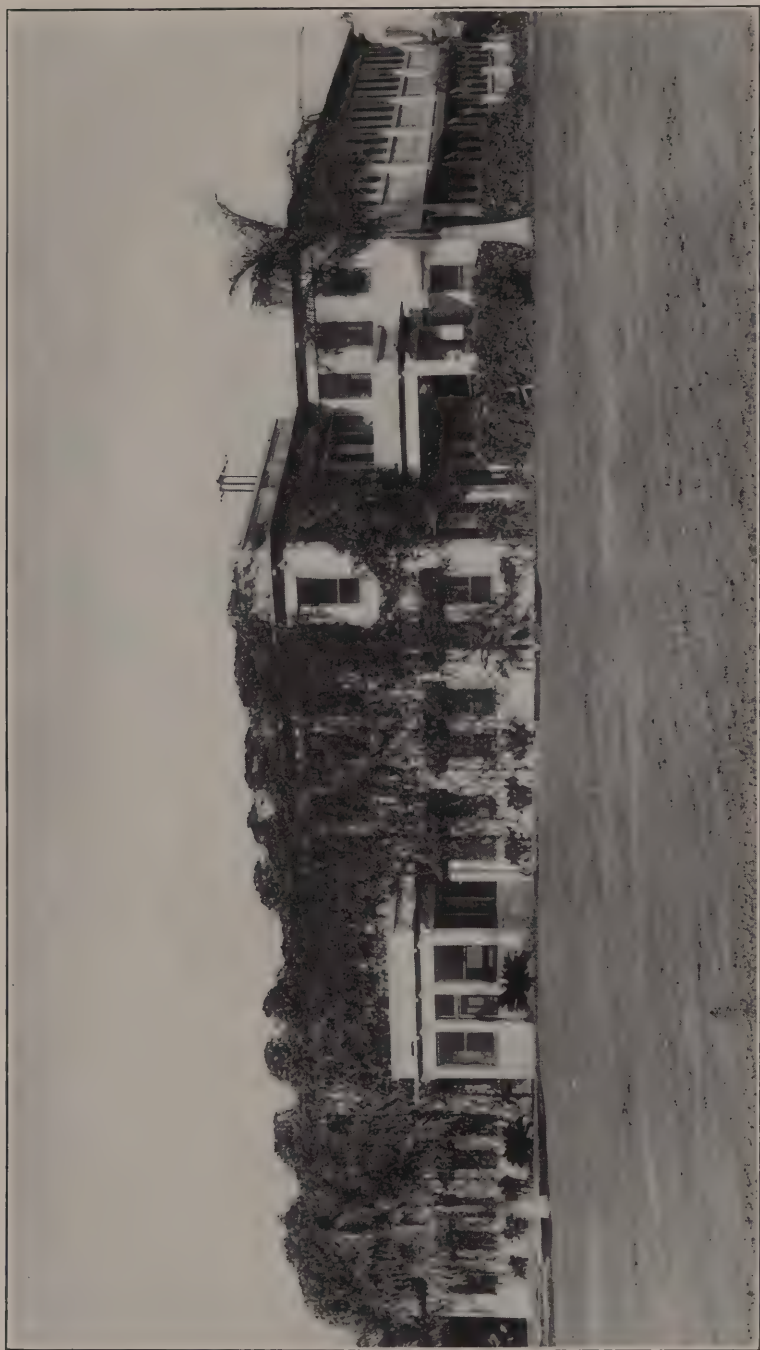
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TRUXILLO RAILROAD HOSPITAL AT PUERTO CASTILLA, HONDURAS

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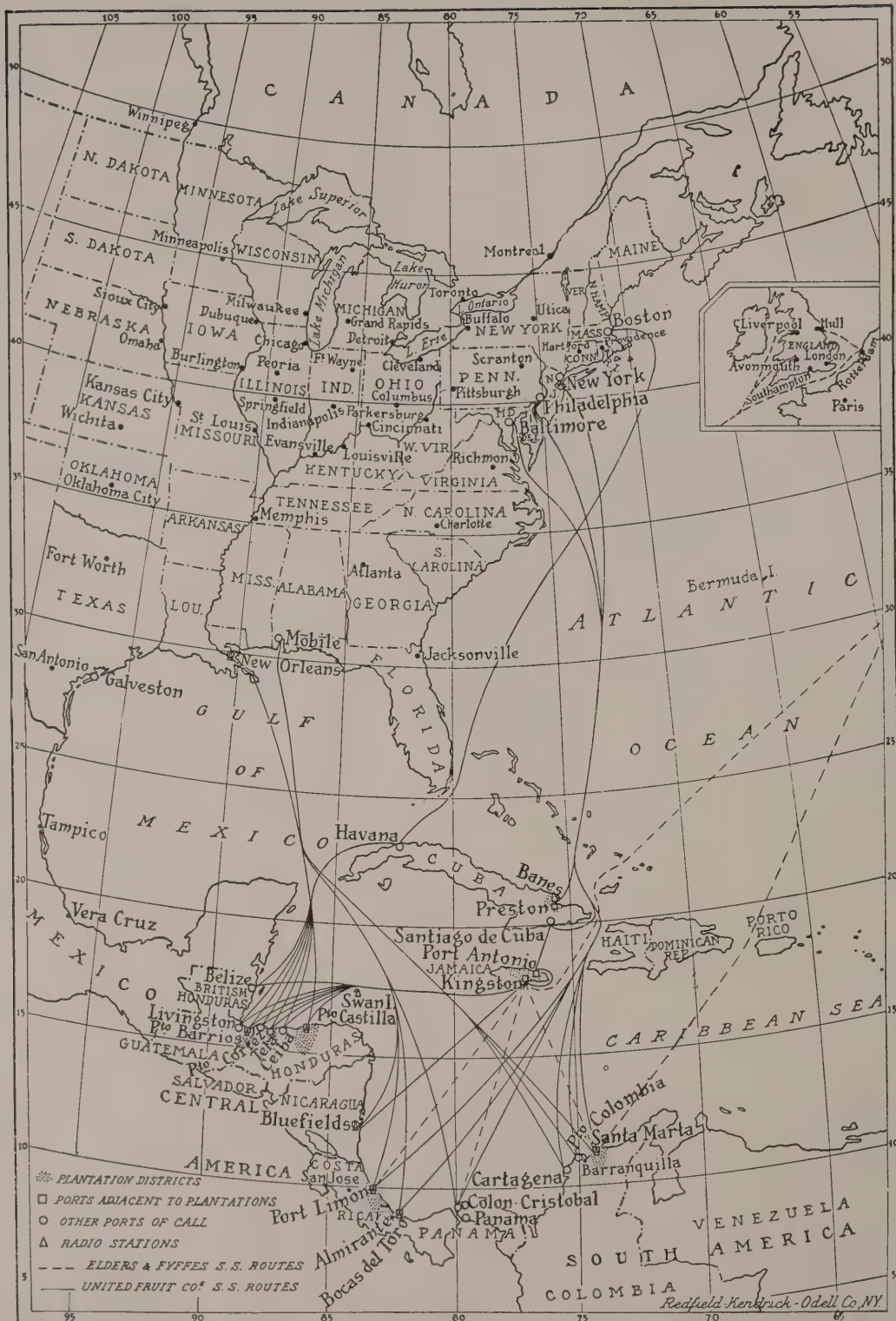
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SECTION I

UNITED FRUIT COMPANY

GENERAL OFFICES, ONE FEDERAL STREET, BOSTON, MASS.

May 1, 1928

MR. V. M. CUTTER, President
United Fruit Company
Boston, Massachusetts

Dear Sir:—

The Annual Report of the Medical Department of the United Fruit Company for the fiscal year ended December 31, 1927, is herewith submitted:

It is very gratifying to be able to report that during the past year considerable progress has been made in controlling the incidence of malaria. The measures employed, and the results obtained, are referred to at considerable length in this Annual Report. Malaria is our major problem, and anything that can be done to mitigate the morbidity resulting therefrom spells progress.

At the beginning of 1926 the following measures were instituted, with the object of controlling malaria morbidity in our tropical divisions:

(1) Efforts at short-radius sanitation about the habitations. These consisted of the well-known measures of destroying mosquito-breeding places, as far as practicable, by the filling and draining of areas containing standing water; and, where this was not possible, the use of Paris green after the manner recommended by Dr. Barber; or, in some localities, the use of oil.

(2) Daily inspection of camps and treatment of the sick cases at an early stage of the disease. Inasmuch as we had determined that about 90 per cent of the sickness in camps was due to malaria, the administration of quinine was given daily to all fever cases; and when improvement did not occur within three or four days, the patients were referred to the hospital for further treatment. The women and children in the camps were similarly cared for.

(3) Attempts to destroy the mosquitoes in and about the habitations, by insecticide sprays. This measure, to be effective, necessitates close cooperation on the part of all intelligent units directly in charge of labor, as well as by the house-dwellers themselves.

The results of these combined efforts have been very satisfactory in all districts where the above measures have been thoroughly applied. The magnitude of the work involved, and the difficulties encountered in obtaining the full cooperation of all the men immediately in charge of labor units (many of whom have a very limited knowledge of sanitary measures or their significance), have prevented the full application of all these methods in all districts.

Mosquito-breeding can be controlled in small areas by short-radius sanitation about habitations, and by this means the incidence of malaria can be greatly lessened. This has been demonstrated in many countries, and is in accordance with our own experience.

Our present efforts, in addition to local sanitation for the control of mosquito-breeding as outlined above, are directed to the cure of human carriers by means of a combination treatment of plasmochin and quinine.

A great deal of work has been done during the past year in determining the limits and dosage of the new drug "plasmochin," which was discussed in last year's Annual Report. The drug is particularly effective in clearing the peripheral blood of gametocytes, which are the adult sexual forms of malarial parasites that infect mosquitoes. Unfortunately, it occasionally produces toxic symptoms when given in large doses over a prolonged period. From two years' experience, we now know its limitations fairly well, and feel confident that its use can be extended to the treatment of camp cases in such dosage as to be effective without causing serious results. This promises to be the most important discovery for malaria-control that has been made since the value of quinine in the cure of malaria was first recognized. Its importance is so great, that considerable space has been devoted in the present Annual Report, in Section II, to discussions of its use by different methods and dosages.

As evidenced by the statistical data, the results of the various methods undertaken for malaria-control are exceedingly encouraging in all the districts where we have been able to obtain full cooperation in sanitary measures as well as in the administration of plasmochin and quinine in combination. The exhibition of this treatment (plasmochin and quinine) has not been in general use in all the divisions during the past year, and in some of them it has been used only for a few months. Apart from Jamaica—where the United Fruit Company does not operate a hospital—in 1926, 11,141 cases of all types of malaria, including the clinical forms, cachexia, and blackwater fever, were treated in the hospitals of the 8 Divisions; and in 1927, 7,986, a reduction of 28.3 per cent. During these years the population, in numbers, did not materially change.

The routine work of the hospitals has been carried on in a very satisfactory manner, and we are glad to be able to report that no quarantinable diseases have developed in any of our divisions during this year, nor has any infectious disease assumed epidemic proportions.

RESEARCH WORK

Following is a list of articles contributed to the Annual Report, relative to research work carried on in the tropical divisions during the past year:

William H. Taliaferro, Ph.D., and Lucy Graves Taliaferro, Sc.D.

"A Precipitin Test in Malaria"

William H. Taliaferro, Ph.D.

"The Results of Schick Tests in Tela, Honduras"

Florence A. Coventry and William H. Taliaferro, Ph.D.

"Hypersensitiveness to Helminth Proteins"

Eugene R. Whitmore, M.D., D.P.H., F.A.C.P.

"Malaria Hemoglobinuria"

M. A. Barber, Special Expert, U.S.P.H.S., W. H. W. Komp, Associate Sanitary Engineer, U.S.P.H.S.

"Some Observations in the Limon and Panama Divisions of the United Fruit Company, with Especial Reference to Certain Measures for the Control of Malaria"

We are again indebted to Sir Aldo Castellani and Dr. W. M. James, for the following important papers. Their world-wide reputations in their respective fields of investigation insure to their contributions a special interest and value for all who are engaged in tropical-research problems:

Sir Aldo Castellani, M.D., F.R.C.P.

"Further Observations on the 'Symbiotic Fermentation Phenomenon.' Its Use in the Differentiation of Certain Micro-Organisms and in the Identification of Certain Carbohydrates."

William M. James, M.D., F.A.C.P.

"Some Observations on Intestinal Amoebiasis Due to Infection with *Entamoeba Histolytica*"

"Notes on a Microscopical Equipment for Use in the Tropics"

The growing interest of the members of our medical staff in the scientific aspects of the work is evidenced by their contributions, and is very gratifying.

Five thousand two hundred and fifty copies of the Fifteenth Annual Report were published and distributed, largely by request.

The Department is grateful for the continued cooperation and support of the officials of the United Fruit Company.

Respectfully,



GENERAL MANAGER

MEDICAL DEPARTMENT

17 BATTERY PLACE, NEW YORK



CABBAGE GROWN IN PRESTON GARDEN



PAPAYA TREE IN PRESTON GARDEN

COMMENTS ON SOME OF THE MORE IMPORTANT DISEASES OCCURRING IN THE TROPICAL DIVISIONS

PNEUMONIA

In the tropical divisions, more deaths are caused by lobar pneumonia than by any other single infection. The number of deaths in the hospitals from all causes in 1927 was 765; 329 cases of lobar pneumonia were treated in the hospitals, and of these 118 died, a mortality rate of 35.8 per cent. Of the cases admitted, 5 were from temperate zones, with 1 death, and the rest of the cases were from the native and negro populations. In 1926, 442 cases of lobar pneumonia were admitted to the hospital, and of these 124 died, a mortality rate of 28 per cent. Although the number of cases in 1927 was smaller than in 1926, the mortality rate was higher. This high mortality rate can be in part accounted for by the following conditions, which prevail among the native and negro laborers:

(1) *Low Racial Resistance to Respiratory Diseases.* — This is demonstrated from the autopsy findings. Rarely indeed are the lesions confined to the pulmonary tissues, but meningitis, pericarditis, empyema, lung abscess, sinusitis, etc., are frequent complications.

(2) *Prevalence of Intercurrent Infections.* — Among these are chiefly malaria, syphilis, and hookworm. As a result of these infections, supplemented by poor nutrition, there is a low haemoglobin average. Dr. Brosius, of the Almirante Hospital, determined the haemoglobin estimations as follows in 100 successive patients admitted to the hospital with malaria infection:

In 15 the haemoglobin ranged between 50 and 60

In 70 the haemoglobin ranged between 61 and 70

In 15 the haemoglobin ranged between 71 and 85

Dr. Clark obtained practically the same results among the Haitians and other negroes who were performing their daily work, but 23.5 per cent of whom were carrying malarial parasites in their blood.

(3) *High Percentage of Illiteracy.* — As a result of this factor, there is an indifference to symptoms and physical conditions, and an advanced stage of the disease frequently develops before hospital treatment is sought.

We have no specific treatment in general use. Dr. Drennan, of the Colombia Division, recommends mercurochrome intravenously, but in order to obtain good results the drug must be used at an early stage of the disease. He reports 54 cases, with 11 deaths (20.3 per cent). Dr. de la Guardia, of the Preston Division, reports 57 cases, with 11 deaths (19.3 per cent). In the treatment of all of his cases, Dr. de la Guardia used thyroid extract and potassium-permanganate rectal injections after the method recommended by Herbert W. Nott, reported in the *British Medical Journal* of July 17, 1926 and referred to in the *Fifteenth Annual Medical Report* of the United Fruit Company (1926), page 104. He gave a thyroid

tablet— $\frac{1}{2}$ grain—(dry, $\frac{1}{10}$ th of a gram) twice daily for a period of 2 weeks, and rectal injections of potassium-permanganate in the following manner:

THE TECHNIQUE

When this treatment is used for pneumonia aperients are avoided as far as possible, for fear of driving intestinal toxins into the circulatory system. The bowels are gradually unloaded by the permanganate injections, or small doses of calomel are given, when evacuation is not as complete as it should be. The solution used is made by adding two grains of pure potassium permanganate to one and a half pints of water, which should be comfortably hot; from three ounces to half a pint are used on each occasion, according to the age of the patient. The fluid should be administered very slowly by means of a funnel and small tube, or by a Higginson's syringe, and the injections repeated from two and one-half to four hours during the first twenty-four to thirty-six hours. The length of the interval between the injections depends upon what day of the disease the case comes under treatment, much in the same way as the dosage and frequency of the subcutaneous injections of serum are judged in the treatment of diphtheria. In ordinary cases, if the treatment is begun on the first or second day of the disease, intervals of three or four hours can be allowed; but when beginning on the fourth or fifth day, especially when the symptoms are severe, the intervals may be reduced to two and half or even two hours. One must be guided also by the quantities the patient is able to retain on each occasion, shorter intervals being necessary when the fluid is quickly returned. Once the temperature reaches normal, in adults and older children, the injections are reduced to two a day for three days, and once a day for three more days, when they can be discontinued; or they can be replaced, to the advantage of some, by giving the combined thyroid and manganese cachets for a week or so. But in infants and younger children the injections should be continued twice daily for at least ten days after the temperature has reached normal, as there is a tendency to recurrence if they are given up too early.

That the methods of treatment employed by Drs. Drennan and de la Guardia merit further trial, is shown by their mortality rates when compared with those in the other divisions, which averaged 44 per cent. In the latter group of hospital cases, symptomatic treatment only was used.

TYPHOID FEVER

Ninety-two cases of typhoid fever were treated in the hospitals, and 15 died, a mortality rate of 17 per cent. Of these 92 cases, 30 occurred in the Banes Division, and of these only 13 were employees; 25 in the Colombia Division, of whom 19 were employees; 18 in the Tela Railroad Company Division, of whom 15 were employees; 12 in the Preston Division, of whom 10 were employees; 4 in the Costa Rica Division, of whom 2 were employees; 2 non-employees in the Guatemala Division; and 1 non-employee in the Panama Division. Of the 15 deaths, 4 were among non-employees. In most of the cases, the sources of infection were traced, and, for the greater number, proved to be from contacts with imported carriers who had polluted either the food or the water supplies. In some cases, unquestionably the infection was conveyed by flies from unprotected dejecta.

In Banes—where more cases were treated in the hospital than in any other division—in order to prevent the disease from assuming epidemic proportions, typhoid vaccination was resorted to. In 1926, 5,437 vaccinations against typhoid were given, and 9,179 in 1927.

PARATYPHOID FEVER

Paratyphoid fever was noted in 16 cases, with 2 deaths.

AMOEBIIC DYSENTERY

In 1927, 424 cases of amoebic dysentery were treated in the hospitals and 5 died, a mortality rate of slightly more than 1 per cent. Of the cases admitted, 89 were non-employees. In 1926, 536 cases were treated, with 17 deaths. In both years, most of the cases occurred in the Colombia Division—in 1926, 302; and in 1927, 156. The greatly decreased incidence in this division can be largely attributed to the improvement in the drinking-water supply. Formerly the laboring population obtained their supply mainly from irrigation ditches. During the past 2 years, however, they have gradually been educated to the use of water from driven wells, which have been installed throughout the farm districts. The method of treatment in these cases is chiefly by emetine injections and large doses of bismuth subnitrate (1 or 2 teaspoonfuls), stirred in a tumbler of water, 3 or 4 times a day. This method of treatment was first instituted in Ancon Hospital, and we know of no remedies which will give us as favorable results. That amoebic infections are of more frequent occurrence than is generally recognized, is shown by Dr. de la Guardia who states:

Following the personal advice of Dr. W. M. James, we did a routine stool-examination in all those cases complaining of vague gastro-intestinal symptoms that were admitted to the hospital or dispensary. Many of these cases were found positive for *Amoeba histolytica* infection (cystic and vegetative forms). They responded very promptly to emetine and bismuth treatment. In one case, diagnosed as chronic appendicitis by 8 physicians, an appendectomy was done. This girl had a sclerotic appendix, with many peri-appendicular adhesions, and the surgical indications were undoubtedly correct; but she did not recover completely from the symptoms. Two months after the operation, an examination of her stools revealed cystic and vegetative forms of *Amoeba histolytica*, and a course of emetine and bismuth treatment promptly relieved her symptoms.

BACILLARY DYSENTERY

Twenty-three cases of bacillary dysentery were treated in the hospitals, with 4 deaths; 7 of these cases were in non-employees. Dr. Menk in his Laboratory Report (page 254) refers to the types treated in the Banes Hospital.

HAEMOGLOBINURIC FEVER

One hundred and forty cases were admitted to the hospitals, and 37 died (26.4 per cent); 35 of the cases were among non-employees, and of these 5 died.

In 1926, 167 cases were treated in the hospitals, with 32 deaths. In both years, the greatest number of these cases occurred in the 3 divisions: Banes, Costa Rica, and Guatemala. The incidence in the various divisions is shown in the statistical data (page 326).

BERI-BERI

Thirty-one cases were admitted to the hospitals in 1927. Of these, 22 cases occurred in the Preston Division, and 5 in the Colombia Division. In 1926, 16 were reported, and of these 15 were in the Colombia Division. In this connection, Dr. de la Guardia makes the following statement:

Our attention has been directed to the incidence of this disease among Cubans, which had not been observed before in this division, as all our previous cases were confined to our Chinese laborers. We have no doubt that the critical economic situation which the country is going through, and which implies inadequate diets (with rice the principal food, and an entire lack of green vegetables due to the drought), is the basic etiological factor responsible for this condition.



Sanitary Drains in Banes Division

SECTION II

PLASMOCHIN IN MALARIA

O. T. BROSIUS, M.D., D.T.M. & H., F.A.C.P.

United Fruit Company Hospital
Almirante, Panama

The symptoms and pathological manifestations in malaria (at times indefinite) are so varied and protean in character that they simulate many other diseases, depending upon the anatomical structures most affected. The personal equation is always an important consideration in administering treatment, of which quinine has always been and still is, in a measure, the drug of paramount importance. Quinine may be indeed considered almost a specific, but bizarre forms of the disease and untoward reactions to the drug in different individuals demand frequent changes in the methods of administration.

Quinine at times produces disagreeable after-effects—weakness, dizziness, tinnitus aurium, deafness, etc.—and patients sometimes react with most uncomfortable and alarming symptoms as a result of idiosyncrasies; and other drugs, in the form of tonics and stimulants, must be administered with it. As quinine appears to affect only the asexual forms of malaria, other specifics have constantly been sought. The arsphenamines, mercurochrome, methylene blue, gentian violet, stovarsol, etc., have been tried, but the results have proved disappointing. Consequently, one is skeptical in accepting new, so-called “malarial specifics,” and is reluctant to respond too readily with favorable reports. Plasmochin, however, has been given a thorough trial during the past year in this as well as in other hospitals of the United Fruit Company, and can be highly recommended.

In this report it is not our intention to refer to the history of the discovery of the drug, its chemistry, or pharmacology, other than to state that it is a synthetic quinolin derivative. The data concerning it are referred to in detail in the German and other literature on the subject, and in the *Fifteenth Annual Report* (1926) of the United Fruit Company's Medical Department. We desire to record herewith as accurately as possible the observations made, relative to this drug, in the treatment of malaria.

Its application is still more or less in the experimental stage, but promises well, in that it apparently has a definite action on the gametocytes; and this is particularly important, since we have known for some time that the sexual forms of the parasite are prone to persist in the peripheral blood for a considerable period, in spite of thorough quinine treatment. Although clinically cured and the peripheral blood smears are free from ring forms, the number of gametocytes in the peripheral blood is appreciably increased. If, therefore, we find that in plasmochin we have a drug possessing a specific action against malarial gameto-

cytes, we must realize that tropical sanitation has been reinforced by an agent that will make the control of malaria decidedly easier. Experience has taught us that quinine will destroy the asexual forms of the disease, to which the symptoms are mainly due; so that if plasmochin proves to have a specific action on the gametocytes, a combination of the two drugs is indicated.

Plasmochin is put up in tablets of 0.02 gram each. Mühlens recommends that this is a safe dose, and says that 3 to 4 tablets can be given daily to the average adult. Gastralgic pains, headache, and cyanosis are early toxic symptoms, and it is claimed that quinine offsets these; wherefore there has been placed on the market a plasmochin-compound tablet which contains plasmochin gram 0.01 and quinine sulphate gram 0.125. The manufacturers have now replaced the latter with a tablet containing plasmochin gram 0.005 and quinine sulphate gram 0.0625. Another type of plasmochin-compound tablet, called plasmochin compound "C," containing plasmochin gram 0.01 and hydroquinine gram 0.125, was temporarily prepared but is not now available. Some cases in the following series were treated with this preparation.

Mühlens believes that the tertian and quartan types of malaria can be satisfactorily treated with plasmochin alone, but recommends 2 plasmochin compound tablets (plasmochin gm. 0.01 and quinine sulphate gm. 0.125) 3 to 4 times a day for malignant-tertian or aestivo-autumnal malaria.

Our experiences have borne out the recommendations of Mühlens that 0.06 gram plasmochin per day alone, or combined with quinine in the form of plasmochin-compound tablets, yields equally good results as larger doses.

Manson-Bahr's observations regarding the shrinkage of malarial spleens with plasmochin treatment have not been found to be constant in our cases, although we have frequently observed remarkable reductions in the size of this organ in acute cases.

The following series of malarial cases were treated as follows: Tertian-malarial cases treated with plasmochin, with plasmochin compound, with large doses of plasmochin, and with plasmochin compound "C"; aestivo-autumnal cases treated with plasmochin compound, with plasmochin compound in large doses, with plasmochin compound plus quinine, and with plasmochin compound "C." Other series show aestivo-autumnal cases of malaria treated with quinine for three days first, and then with plasmochin compound. Series of cases treated in the out-patient department and in camps are also shown.

Treatments for hookworm and round worm, as well as for syphilis and other diseases, were always administered along with the treatment of malaria, since it has long been an established fact that malaria always responds more quickly to treatment if other associated conditions are simultaneously corrected.

In handling the following series of cases, we treated them largely in accordance with the recommendations contained in the literature on the subject. We kept the cases in the hospital as long as was practicable, and during this time daily blood-examinations were made by the thick-film method. Often it was difficult,

and sometimes even impossible, to keep the patients in the hospital or even under observation as long as was desirable, but the excellent cooperation which the large majority of our patients gave in returning for blood-examinations and for treatment in accordance with our instructions, was gratifying. Untoward toxic symptoms and signs such as gastric pains and distress, cyanosis, headaches, and dizziness occurred not infrequently, but produced no serious permanent effects, and soon disappeared when the drug was discontinued.

After the patients were discharged from the hospital, they were instructed to return within from 4 to 5 days for another blood-examination; then more of the drug was given them for treatment at home. Thus, as they came back at regular intervals for blood-examinations, fairly good checks could be kept on the approximate efficiency of the drug.

It is believed that a complete malarial treatment with plasmochin compound supplemented with quinine will be cheaper in the end to cure the patient than a treatment with quinine alone, because so much less medication will be necessary, owing to the destructive action of plasmochin on the sexual forms that infect mosquitoes.

Editor's Note. — Dr. Brosius submitted for publication the individual daily records of 265 cases treated in the hospital by plasmochin alone or in combination with quinine sulphate in different dosages; and also the hospital records of 15 of these 265 cases that relapsed or developed blackwater fever. It is believed that the purposes of his voluminous data will be satisfactorily served if we fully tabulate only those cases which showed toxic symptoms, relapses, or blackwater fever, or which died.

The same method is followed in reporting data on 120 cases treated in the outpatient clinic. Only the persistent cases are tabulated.

The cases similarly treated in the different series or groups and not individually tabulated, apparently recovered as none of them reported back for further treatment within the period of Dr. Brosius' observations (approximately 8 months).

All of the 44 cases in Series I, below, are fully tabulated because they show the effects of large doses of quinine over a 3-day period in determining gametocytes to the peripheral blood, whereas in most cases they were absent on the first examination.

This condition did not develop, as shown in the other series, when plasmochin treatment with or without quinine was administered from the 1st day of admission to the hospital. This series of cases corroborates the conclusions reached by Dr. H. C. Clark.¹ He found that short periods of treatment with quinine alone caused the disappearance of the clinical symptoms, and the schizonts from the peripheral blood; and yet, of 124 cases of aestivo-autumnal malaria cases treated in the hospital with 30 or more grains of quinine daily for an average period of 1 week, 45.9 per cent still carried crescents when discharged. Cordes² confirmed this observation; Whitaker³ obtained similar results; and it will be noted that Series I bears out their findings.

The work of Darling, Ross, Barber, and Wenyon shows that gametocytes developed during quinine administration are viable and infectible to mosquitoes. In this connection, the reader is referred to Barber and Komp's article (see page 54 of the present *Annual Report*).

1. See *Fifteenth Annual Report* (1926), Medical Department, United Fruit Company.

2, 3. See articles by Cordes and Whitaker in the present *Annual Medical Report*.

In a small number of cases treated with plasmochin for short periods, the gametocytes became non-viable and non-infectible to mosquitoes. Further observations are necessary to confirm this important finding. A confirmation of it would prove conclusively the great value of plasmochin in malaria control.

For the series of tabulated reports here presented, the following list explains the abbreviations, etc., that are used to indicate the drugs and the species of malaria treated:

1. P., stands for plasmochin
 2. P.C., plasmochin compound
 3. P.C.C., plasmochin compound "C"
 4. Q., quinine
 5. T., tertian
 6. Qt., quartan
 7. E.A., aestivo-autumnal
 8. D.T., double tertian
 9. M., mixed infections
- } Malaria
10. 0., means "nothing," whether it means "no treatment" in the "treatment" line, or "no examination" in the "blood report" line.
 11. +, positive blood smear
 12. -, negative " " "
 13. Various complications are abbreviated as:

Syph.	for syphilis
Unc.	" uncinariasis
Asc.	" ascariasis
Herp. Zoster	" Herpes Zoster
Neph.	" nephritis
Car. t.	" carious teeth
Dh. itch	" Dhobie's itch
D. caries	" dental caries
Ing. adenitis	" inguinal adenitis
Gon.	" gonorrhoea
Ing. hernia	" inguinal hernia
 14. Ch. stands for chenopodium treatment for uncinariasis and ascariasis given during the various plasmochin courses.
 15. Other abbreviations and symbols scarcely need explanation, as Op. for operation and 914 for intravenous neosalvarsan.
 16. (1) over the sex indicates 1st-class patient—and usually means white race.

Along with each case of the tabulated series three lines are shown. The top line gives, in the metric system, the dose per day of the plasmochin administered. The second line indicates the dose per day, also in the metric system, of the quinine given. It is understood that these doses are divided into three portions given morning, noon, and night. A zero means that no drug was given. The third line indicates the result of the blood-smear examination, whether + positive or - negative; and 0 means "none made."

[illegible]

Case No.	Sex	Age	E.A.	P.C.	Notes
21,019	F.	35	-	-	Discharged from the hospital on the 11th day. On the 14th day, returned for blood-examination and was found +.
21,103	M.	35	-	-	Discharged from the hospital on the 11th day. On the 14th day, returned for blood-examination and was found +.

SERIES E. — F.A. MALARIA CASES RECEIVING 1 PLASMOCHIN TABLET 0.02 GR. AND 1 QUININE TABLET 0.33 GR. T.I.D.

[illegible]

SERIES F.—E.A. MALARIA CASES RECEIVING LARGER DOSES OF PLASMOCHIN COMPOUND
(8 Tablets per Day)

20,311	40	M.	E.A.	P.C.	Syph.	.08 1.	.08 1.	.08 1.	.08 1.	.08 1.	0	0	0	0	.06 .75	.06 .75	.06 .75	0
(The patient relapsed 12 days after the last dose of plasmochin compound.)																		
20,866	17	F.	E.A.	P.C.	Asc. Leg ulcer	.08 1.	.08 1.	.08 1.	.08 1.	.08 1.	Ch.	.08	0	0	0	0	0	0
(Subsequent blood-examinations until the 40th day continued negative.)																		
20,867	35	M.	E.A.	P.C.	Syph. Asc.	.08 1.	.08 1.	.08 1.	0	0	0	0	0	0	0	0	0	0
(The patient died on the 5th day. See "Autopsy Diagnosis," page 42.)																		
20,905	32	M.	E.A.	P.C.	-	.08 1.	.08 1.	.08 1.	.08 1.	.08 1.	0	0	0	0	.04 .5	.04 .5	.04 .5	0
(This case returned for blood-examination 11 days after the last treatment of plasmochin compound. He developed fever, and parasites were found E.A+.)																		

21,043 32 M.	E.A.	Q.	Unc.	3.	3.	3.	.06	.06	.06	.06	.06	.06	Ch.	.06	0	0	0	0	0	0	.04	.04	.04	.04	.04
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-	.65	.65	.65	.65	.65
		P.					+	+	+	+	+	+	+	+	+	+	+	+	+	+	0	0	0	0	0
21,046 25 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	Ch.	.06	.06	Ch.	.06	.06	0	0	0	0	0	0					
		&		3.	3.	3.	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-					
		P.		+	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0					
21,055 13 M.	E.A.	Q.	Unc.	2.	2.	2.	.06	.06	Ch.	.06	.06	Ch.	.06	.06	0	0	0	0	0	0					
		&	Asc.	+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-					
		P.	Gon.	+	+	+	+	+	+	+	+	+	+	+	0	0	0	0	0	0					
21,056 20 M.	E.A.	Q.	Unc.	3.	3.	3.	.06	.06	Ch.	.06	.06	Ch.	.06	.06	0	0	0	0	0	0	.04	.04	.04	.04	.04
		&	Syph.	+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-	.65	.65	.65	.65	.65
		P.		+	+	+	+	+	+	+	+	+	+	+	0	0	0	0	0	0	0	0	0	0	0
21,054 30 M.	E.A.	Q.	Gon.	3.	3.	3.	.06	.06	.06	.06	.06	Ch.	.06	.06	.06	.06	.06	.06	.06	.06					
		&	Asc.	+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	+	+	+	+	+	+					
		P.		+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-					
21,067 4 F.	E.A.	Q.	Asc.	1.	1.	1.	.01	.02	.01	.02	.01	.02	0	0	0	0	0	0	0	0	.01	.01	.01	.01	.01
	+	&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-	.75	.75	.75	.75	.75
		P.		+	+	+	+	+	+	+	+	+	+	+	0	0	0	0	0	0	0	0	0	0	0
21,064 21 M.	E.A.	Q.	Unc.	3.	3.	3.	.06	.06	.06	Ch.															
		&		+	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-					
		P.					.75	.75	.75	.75	.75	.75	.75	.75											
21,070 20 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06					
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75					
		P.		+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-					
21,073 36 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	.06	.06	.06	.06	.06	.06	0	0	0	0	0	0					
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-					
		P.		+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-					
21,085 23 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	.06	.06	Ch.	.06	.06	Ch.	.06	.06	.06	.06	.06	.06					
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	+	+	+	+	+	+					
		P.		+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-					
21,086 43 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	.06	.06	.06	.06	.06	.06	0	0	0	0	0	0					
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-					
		P.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
21,092 35 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06					
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75					
		P.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
21,093 22 M.	E.A.	Q.	-	3.	3.	3.	.06	.06	.06	.06															
		&		+	+	+	.75	.75	.75	.75	.75	.75	.75	.75	-	-	-	-	-	-					
		P.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					

COMMENTS

Series A. — This comprised 60 cases treated in the hospital. On the first examination tertian malarial parasites were found in all of them and aestivo-autumnal parasites also in a small number. Unquestionably more of them had an aestivo-autumnal infection also than were at first recorded, as is shown by the cases that relapsed or developed blackwater fever. Plasmochin only, .06 gram daily, was given to most of the cases. In a few, as shown in those tabulated, supplemental quinine in small doses was also added. In the 60 cases the bloods became negative, as follows: 1 on the 2nd day, 3 on the 3rd day, 30 on the 4th day, 20 on the 5th day, 5 on the 6th day, and 1 on the 7th day. All the cases in this series that developed toxic symptoms or blackwater fever, as well as those that relapsed, and the dates of relapses, are tabulated. Some of the cases recorded as relapses in this and the other series also may have been reinfections, as the intervals between the last day of treatment and the day of relapse were long in some of the cases, and the patients had returned to the same infected areas where they had originally contracted malaria. Three cases in this series developed blackwater fever.

Series B. — In this series of 18 cases of tertian malaria, treated with larger doses of plasmochin, the results did not materially differ from those in Series A. The blood of 1 case became negative on the 2nd day, 6 on the 4th day, 6 on the 5th day, 2 on the 6th day, 1 on the 7th day, 1 on the 8th day, and 1 on the 10th day. In this series there were 5 relapses, one of which developed blackwater fever.

The inference can be drawn from a study of the cases in Series A and B, that plasmochin without quinine does not prevent relapse, nor the development of blackwater fever. In the whole series of 385 cases treated in the hospital and the out-patient clinic, 5 cases of blackwater fever were observed; and of these, 4 occurred in Series A and B. The other case was admitted to the hospital with this condition already developed. Though larger doses of plasmochin were used in the treatment of the cases in Series B than in Series A, no better results were observed.

Series C. — In this series, 25 tertian cases were treated daily with plasmochin 0.06 gram and quinine sulphate 1 gram. Only 2 cases are tabulated. The others recovered uneventfully, with no untoward symptoms. In 1 case the blood was positive on the 16th day after several negative examinations, and the other case died on the day of admission. The autopsy findings, as reported by Dr. F. B. Mallory, were as follows:

Lung. — Congested; fairly numerous lymphocytes and some phagocytic endothelial leukocytes in the vessels. Small amount of exudate in air sacs; fibrin, polymorphonuclear and endothelial leukocytes and lymphocytes.

Spleen. — Congested, foci of necrosis with much fibrin formation; also of sclerosis, with pigmentation (hemosiderin) and calcification of necrotic elastic tissue.

Moderate infiltration with lymphocytes and plasma cells. Malarial pigment present in small amount. *Liver*. — Congested; liver cells compressed, many of the nuclei vacuolated (glycogen). Small granules of brown (malarial) pigment in some of the endothelial cells lining the sinusoids. Fairly numerous lymphocytes in blood stream. *Pancreas*. — Negative. *Kidney*. — Slight brownish (hemosiderin) pigmentation of some of the renal cells in convoluted tubules. *Lymph Node*. — Enlarged; pigmented with hemosiderin in places. Sinuses dilated; contain phagocytic endothelial leukocytes and plasma cells. *Adrenal*. — Negative. *Thymus*. — Negative. *Microscopic Diagnosis*. — (1) Pneumonia (very slight); (2) Malaria with necrosis, sclerosis, and pigmentation of spleen.

In this series the bloods of 8 cases became negative on the 5th day, 15 on the 6th day, and 1 on the 7th day. As can be observed, this method of treatment gave better results than that of either Series A or Series B.

Series D. — This series of 40 cases of aestivo-autumnal malaria was treated with plasmochin .06 gram and quinine sulphate .75 gram daily. Seven cases that showed interesting features are tabulated, and the notes are self-explanatory. The bloods of the 40 cases became negative as follows: 1 on the 3rd day, 22 on the 4th day, 9 on the 5th day, 4 on the 6th day, 2 on the 7th day, 1 on the 8th day, and 1 on the 9th day.

Series E. — In this series of 28 cases of aestivo-autumnal malaria that received .06 gram of plasmochin and 0.1 gram of quinine sulphate daily, 2 cases are tabulated. There was one death, with the following post-mortem report by Dr. Mallory:

Heart. — Negative. *Lung*. — Somewhat compressed; endothelial leukocytes and plasma cells in walls, in places. Moderate pigmentation. A few air sacs are filled with blood. *Spleen*. — Congested. Small amount of malarial pigment present. Lymph nodules and blood vessels negative. Blood sinuses contain numerous phagocytic endothelial leukocytes filled with red-blood corpuscles and other leukocytes. Occasional mitosis in endothelial leukocytes. Some infiltration with lymphocytes. Several focal lesions present, about size of miliary tubercles, composed of endothelial and polymorphonuclear leukocytes. *Liver*. — Great numbers of phagocytic endothelial leukocytes in blood sinuses. Inclusions consist of red-blood corpuscles, lymphocytes, and polymorphonuclear and endothelial leukocytes. A few mitoses found. Several focal lesions present, composed of endothelial and polymorphonuclear leukocytes and fibrin. Considerable inflammatory reaction in portal areas with polymorphonuclear and endothelial leukocytes in some of the bile ducts. A little malarial pigment present in some of the endothelial leukocytes. *Adrenal*. — Slight focal infiltration with lymphocytes. *Cerebrum*. — Negative. *Microscopic Diagnosis*. — (1) Malarial infection; (2) Early lesions of typhoid fever. The lesions in the spleen and liver are characteristic.

In this series the blood became negative as follows: 4 on the 4th day, 14 on the 5th day, 8 on the 6th day, and 1 on the 7th day.

Series F. — This series of 20 cases of aestivo-autumnal malaria was treated daily with plasmochin .08 gram and quinine sulphate 1 gram; 4 cases are tabulated (1 died); the others recovered uneventfully. The bloods became negative as follows: 4 on the 4th day, 7 on the 5th day, 5 on the 6th day, 3 on the 7th

day. The other case died on the 5th day, and post-mortem findings were as follows:

Body. — Emaciated. *Heart.* — Apparently normal. *Lungs.* — Adhesions to apices and to pericardium. *Liver.* — Left lobe hob-nailed. *Spleen.* — Enlarged to about one-half the size of the liver; capsule thickened and some adhesions. (No microscopic examination.)

Series G. — In this series 11 cases of aestivo-autumnal malaria were treated with plasmochin C; and 2 cases are tabulated, with explanatory notes.

Series H. — In this series 13 cases of tertian malaria were treated with plasmochin C, and one interesting case is tabulated. As plasmochin C is not marketed, and as the clinical results with its use do not materially differ from those obtained with the other plasmochin-compound preparations no further remarks on Series G and H are indicated.

Series I. — In this series, all of the 44 cases are fully tabulated, and therefore self-explanatory. It will be noted that 1 case died before the blood became negative, and another was discharged before a negative result was obtained. The case that died was 86 years of age, and an autopsy was not permitted. He had no toxic symptoms from plasmochin, and this drug apparently had no bearing on the cause of death. The clinical diagnosis was:

(1) Myocarditis, (2) Arterio-sclerosis, (3) Chronic nephritis, (interstitial), (4) Hypertrophied prostate, (5) Aestivo-autumnal malaria, (6) Retention of urine, (7) Uncinariasis, (8) Anaemia, (9) Senility.

In this series of cases there were no relapses and no cases of haemoglobinuria. It is quite evident that this method of treatment is not as efficient as that wherein the plasmochin is administered along with quinine from the beginning.

*Series J.** — This series records 1 case only, admitted with blackwater fever. He also had a *Clonorchiosis-sinensis* infestation. He received .06 gram plasmochin for 7 successive days, then chenopodium treatment on the 8th day. The same dosage of plasmochin was given for 4 days subsequently, and he made an uneventful recovery. This case shows that plasmochin can be safely given to patients suffering from blackwater fever.

*Series K.** — This series consists of 5 cases treated in the out-patient clinic. The method of treatment was similar to that given in series M, 20 cases of which are tabulated. The bloods of 4 of the cases became negative within from 2 to 4 days. One of the cases had a severe mixed infection, refused hospital treatment, and died of pernicious malaria on the 5th day after he was first seen. He had taken treatment for 2 days only, and autopsy was not permitted.

*Series L.** — This series records the 2nd admissions of 15 cases that relapsed. They all made uneventful recoveries after the 2nd course of treatment, and there is nothing special to note.

* Because of the nature of Series J, K, and L, it was not considered necessary to present them in tabular form.

Series M. — This series consists of 120 cases treated in the out-patient clinic. Twenty of the cases are fully tabulated; these are the only cases in the series whose bloods continued positive after the first examination. The bloods of the other 100 cases in the series remained permanently negative on subsequent examinations. Many of the cases were school children, and the dosage was modified according to their ages and weights. The tabulated series shows the dosage of plasmochin and quinine given, and it will be noted that 11 of the 20 cases were aged 12 years or under, and with these the dosage was small; 3 of the adults received daily only 0.04 gram instead of 0.06 gram. The patients were given the medicine to take home with them, and they took it for 4 days each week, for 4 consecutive weeks. A thick-film blood smear of each patient was examined at the end of each week.

At the end of the 1st week—i.e., after a 4-days treatment followed by a 3-day interval, 18 out of 115 cases (15.6%) who returned for examination were still positive. At the end of the 2nd week, 5 out of the 106 cases (4.7%) who returned for examination were still positive. At the end of the 3rd week, 92 cases returned for examination and only 1 was positive. During the 4th week of treatment, United Fruit Company Pink Tonic Tablets were administered. These are a modification of the Aiken's Tonic Tablet; each contains 2 grains of quinine. Of the 70 cases that returned for a 4th thick-film blood-examination, none was found to be positive.

The smears were very carefully examined, but as only 1 film was examined after each course of treatment, with a subsequent lapse of 3 days, it is quite probable that 1 or 2 more daily examinations would have increased our number of positive smears.

A study of this series must be convincing that it is safe to administer plasmochin with quinine in moderate dosage in the dispensary clinic, and that this combination is an efficient therapeutic agent.

That this conclusion seems justified, and that this method of treatment has a curative value in many cases of malaria, is demonstrated in some of the treated cases admitted to the hospital later with other conditions.

In the series of 385 cases above recorded, 17 returned to the hospital for other conditions during the 8 months in which these observations were made. Their blood smears were examined daily or bi-daily and all were found to be free from parasites, in spite of the fact that these individuals were all more or less subject to reinfection in their various homes. The 17 readmitted cases, and the conditions for which they were readmitted, were the following: (1) Pyelitis; (2) Venereal disease; (3) Lacerated wound; (4) Abscess; (5) Tonsilitis; (6) Dermatitis, undertermined; (7) Obstetrical case; (8) Obstetrical case; (9) Nephritis; (10) Infected lacerated wound; (11) Uterine fibroids (operated sub-total hysterectomy); (12) Gastritis; (13) Epididymitis; (14) Lacerated wound; (15) Syphilis, uncinariasis, and scabies; (16) Syphilis and coryza; (17) Bronchitis.

In conclusion, I believe it is safe to recommend that plasmochin and quinine had best be given together for all types of malaria. As suggested in the beginning of this paper, the matter of the “personal equation” is important—some individuals reacting better to one drug alone, and some to another—but in the main I believe that the best dosage for the average adult is plasmochin gram 0.06 and quinine gram 2 per day, divided into 3 doses for 4 or 5 days; then the blood should be examined during an interval of several days and treatments should be repeated, based on the laboratory findings.

SUPPLEMENT

As a further investigation regarding the efficacy of plasmochin compound, it was considered advisable to treat and attempt to “clean up” one of our nearby camps. One-Mile camp was the nearest, and it was selected.

In this investigation, we were most fortunate to have the excellent cooperation of Dr. Barber and Mr. Komp (U.S.P.H.S. men), who examined thick-film blood smears from the 339 inhabitants of this camp and found among them 32 positives. Mr. Komp then made a house-to-house inspection for mosquitoes, but no Anopheles could be found.

I then conducted the treatments personally, going out to One-Mile three times a day and seeing that each person really took the medicine. With those individuals who appeared twice a day only for medicine, the dosage was increased. As a whole, the children received rather larger doses of plasmochin than Young’s rule would allow. They were under constant observation, but none of them showed any toxic symptoms from the drug.

Of the 32 positives, only 30 appeared for treatment; and of these, 3 appeared for treatment on 1 day only. Twenty-seven out of the 32 took a complete course of treatment, and of these only 25 appeared on the 7th day for a blood-smear examination. Dr. Barber and Mr. Komp informed me that for this examination an exceptionally large drop was examined, and more than double the usual amount of time was spent in examining each slide. In the examination of this series of 25 cases, a single crescent was found in one of the films; 96% of the cases were apparently cured in 6 treatments.

A detailed report of 25 cases who took the full treatment and whose bloods were examined on the 7th day, is tabulated as Series N, herewith.

NOTE: — In this and the following tables a “c” indicates the presence of crescents, while the ring forms are indicated by “o.”

SERIES N

Age	Sex	Type of Parasite	Treatment	Days						Last Exam.
				1	2	3	4	5	6	
3	M.	E.A. o+	P.C. & Q.	0.015	0.015	0.02	0.02	0.02	0.02	-
				.5	.5	.62	.5	.87		
3	F.	E.A. c	“	0.015	0.01	0.005	0.01	0.005	0.01	No examina- tion
				.25	0.3	0.12	0.3	0.175	0.3	

Age	Sex	Type of Parasite	Treatment	1	2	3	Days 4	5	6	Last Exam. 7
4	M.	E.A. ^{o+} _c	P.C. & Q.	0.02 0.45	0.02 0.45	0.025 0.5	0.025 0.5	0.025 0.5	0.025 0.5	-
5	F.	E.A. ^c	"	0.025 0.75	0.025 0.75	0.03 0.87	0.03 0.87	0.03 0.75	0.03 0.87	-
33	F.	E.A. ^{o+}	"	0.02 .5	0.035 1.25	0.015 0.4	0.035 .9	0.04 1.25	0.035 1.25	-
34	F.	E.A. ^o	"	0.04 1.5	0.04 1.25	0.045 1.62	0.04 1.00	0.045 1.00	No treatment	-
18	F.	E.A. ^o	"	0.045 1.6	0.04 1.0	0.04 1.0	0.045 1.6	0.04 1.25	0.04 1.25	-
13	M.	Q. ^o	"	0.04 1.0	0.04 1.0	0.04 1.0	0.03 0.87	0.04 1.0	0.04 1.0	-
12	F.	T. ^{o+}	"	0.04 1.0	0.04 1.0	0.04 1.5	0.03 1.25	0.04 1.0	0.04 1.0	-
25	F.	E.A. ^o	"	0.02 0.5	0.035 0.9	0.035 0.75	0.035 0.75	0.015 0.4	0.04 1.25	-
11	M.	T. ^o	"	0.04 1.0	0.04 1.0	0.04 1.0	0.03 0.87	0.04 1.0	0.04 1.0	-
8	F.	E.A. ^o	"	0.01 0.4	No treatment	0.025 0.75	0.03 0.87	0.03 0.87	0.03 0.87	-
23/4	M.	E.A. ^c	"	0.01 0.2	0.01 0.2	0.01 0.2	0.01 0.2	0.015 0.25	0.015 0.25	-
7	M.	E.A. ^{o+} _c	"	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	0.025 0.75	0.025 0.75	-
7	F.	E.A. ^o _c	"	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	0.035 0.9	0.03 0.87	-
7	M.	Q. ^o	"	0.03 0.87	0.02 0.75	0.02 0.75	0.025 0.87	0.02 0.75	0.025 0.75	-
6	F.	E.A. ^{o+}	"	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	-
6	F.	E.A. ^{o+}	"	0.03 0.5	0.02 0.75	0.01 0.4	0.02 0.75	0.03 0.87	0.02 0.75	No examination
5	F.	E.A. ^c	"	0.02 0.75	0.02 0.75	0.03 0.87	0.02 0.75	0.03 0.87	0.03 0.87	1c +
4	F.	E.A. ^o	"	0.02 0.5	0.02 0.5	0.02 0.5	0.025 0.5	0.02 0.5	0.025 0.87	-
4	F.	E.A. ^o _e	"	0.02 0.5	0.02 0.5	0.025 0.6	0.02 0.5	0.02 0.5	0.025 0.87	-
9	F.	E.A. ^o	"	0.03 0.87	0.03 0.87	0.03 0.87	0.04 1.0	0.04 1.0	0.04 1.0	-
2	F.	E.A. ^o	"	0.01 0.2	0.015 0.2	0.02 0.03	0.015 0.02	0.01 0.02	0.015 0.5	-
26	M.	T. ^{o+}	"	0.02 0.75	0.25 0.75	0.045 1.25	0.03 1.25	0.03 1.0	0.04 1.75	-

Age	Sex	Type of Parasite	Treatment	1	2	3	Days 4	5	6	Last Exam. 7
29	M.	Q. ^o	"	0.04 1.75	0.04 1.75	0.04 1.5	0.04 1.5	0.04 1.5	0.04 1.5	-
28	F.	E.A. ^{o+}	"	0.04 1.25	0.035 1.25	0.045 1.25	No treat- ment	0.04 1.25	0.045 1.5	-
7	M.	E.A. ^o	"	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	0.03 0.87	0.02 0.75	-

In the survey no Anopheles nor anopheline breeding places were found in or about the camp, but on a farm situated about $\frac{1}{2}$ mile away Dr. Barber found both *A. albimanus* and *A. punctimacula* breeding in considerable numbers.

SERIES O

This series consists of 41 cases found positive for malaria from Dos Canos Camp, out of 150 examined by Dr. Barber and Mr. Komp in one of their recent camp surveys. Of this series, 36 cases only that took the complete course of treatment are tabulated:

Age	Sex	Type of Parasite	Treatment	1	2	3	Days 4	5	6	Last Exam. 7
6	M.	E.A. +	P.C. & Q.	0.03 1.0	0.03 0.75	0.03 0.75 +c	0.03 0.375	0.03 0.75 +c	0.03 0.375	0
7	M.	E.A. +	"	0.03 1.0	0.03 0.75	0.03 1.0 +c	0.03 0.375	0.03 1.0 -	0.03 0.375	0
9	F.	E.A.	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0
8	M.	E.A. +	"	0.03 1.0	0.03 0.375	0.03 0.75 -	0.03 0.375	0.03 0.75 -	0.03 0.375	0
5	F.	E.A. +	"	0.03 0.75	0.03 0.375	0.03 0.75 +c	0.03 0.375	0.03 0.75 -	0.03 0.375	0
8	F.	E.A. +	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0
10	F.	E.A. +	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0
11	F.	E.A. +	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0
9	M.	E.A. c+	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0
8	M.	E.A. +	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0
2	M.	E.A. +	"	0.015 0.3	0.015 0.185	0.01 0.25 +o	0.01 0.25	0.01 0.25 -	0.01 0.25	0
12	M.	Q. ^{o+}	"	0.03 1.0	0.03 0.375	0.03 1.0 -	0.03 0.375	0.03 1.0 -	0.03 0.375	0

Age	Sex	Type of Parasite	Treatment	1		3	Days 4	5	6	Last Exam. 7
						—		—		
9	M.	E.A. +	P.C. & Q.	0.03 1.0	0.03 0.375	0.03 1.0	0.03 0.375	0.03 1.0	0.03 0.375	0
4	M.	E.A.	"	0.03 0.75	0.03 0.375	0.03 0.75	0.03 0.375	0.015 0.5	0.015 0.1	0
						—		—		
7	M.	E.A. +	"	0.03 1.0	0.03 0.375	0.03 0.75	0.03 0.375	0.03 0.75	0.03 0.375	0
						+o		—		
13	M.	E.A.	"	0.045 1.2	0.045 0.45	0.03 1.0	0.03 0.375	0.03 1.0	0.03 0.375	0
						—		—		
4	M.	E.A. c+	"	0.03 0.75	0.03 0.375	0.03 0.75	0.03 0.375	0.03 0.75	0.03 0.375	0
						+o		—		
						c				
2	F.	E.A. c+	"	0.015 0.3	0.015 0.185	0.015 0.3	0.015 0.185	0.01 0.25	0.01 0.25	0
						+c		—		
29	F.	E.A.	"	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0.04 1.25	0.04 0.5	0
						—		—		
28	M.	E.A. +	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
16	F.	E.A. c+	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						+c		—		
16	F.	E.A. c+	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
43	F.	E.A.	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
55	F.	E.A.	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						+o		—		
37	F.	E.A. +	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
16	F.	E.A.	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						+c		—		
49	M.	E.A. +	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
34	M.	E.A.	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
20	M.	E.A.	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
23	M.	E.A. +	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		
15	M.	E.A.	"	0.06 1.4	0.06 0.75	0.06 1.4	0.06 0.75	0.04 1.25	0.04 0.5	0
						—		—		

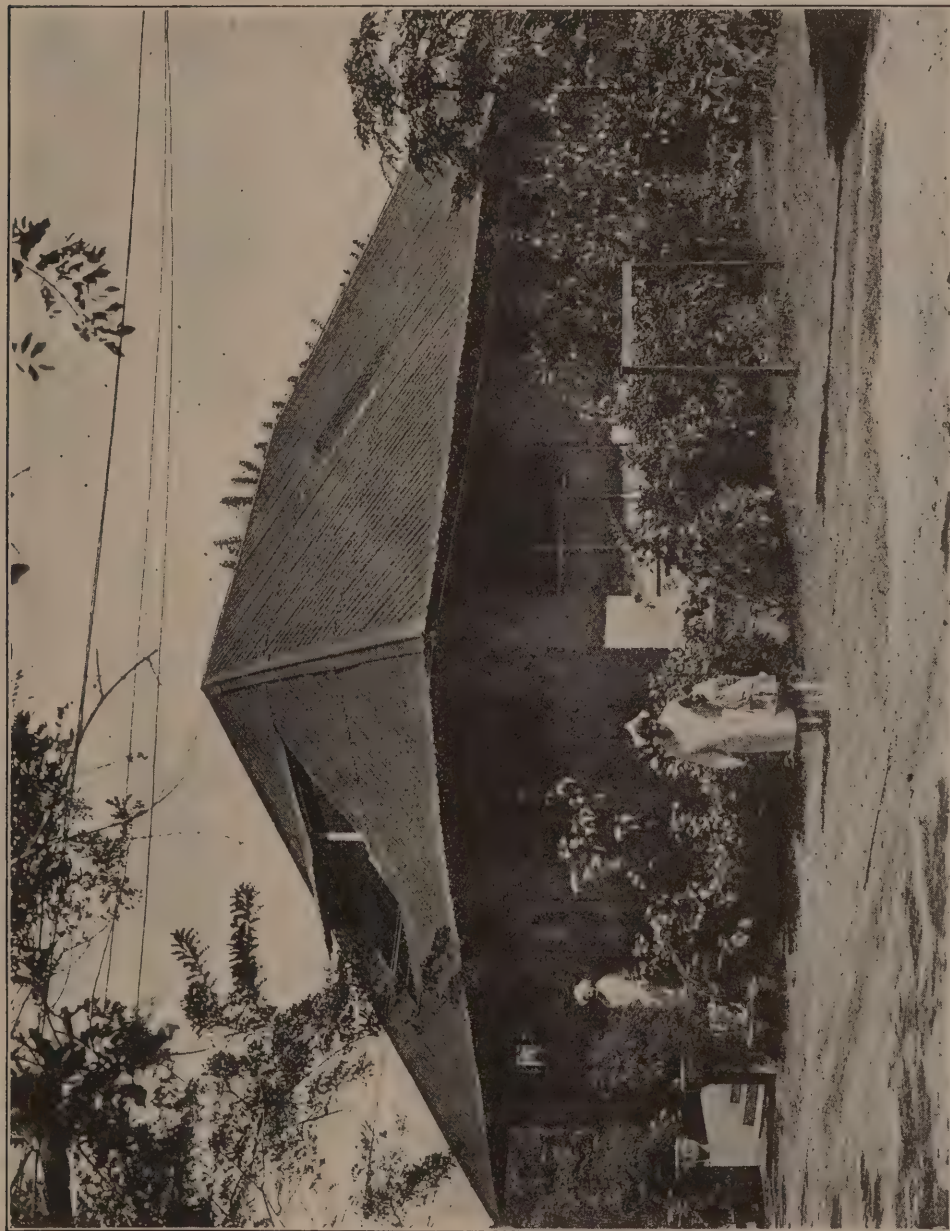
Age	Sex	Type of Parasite	Treatment	1	2	3	Days 4	5	6	Last Exam. 7
38	M.	E.A.	P.C. & Q.	0.06 1.4	0.06 0.75	0.06 1.4 —	0.06 0.75	0.04 1.25 —	0.04 0.5	0
18	M.	E.A. +	"	0.06 1.4	0.06 0.75	0.06 1.4 +c	0.06 0.75 —	0.04 1.25	0.04 0.5	0
4	F.	E.A. +	"	0.03 0.75	0.03 0.375	0.03 0.75 —	0.03 0.375	0.03 0.75	0.03 0.375	0
12	F.	E.A.	"	0.03 1.0	0.03 0.375	0.03 1.0 —	0.03 0.375	0.03 1.0	0.03 0.375	0
10	M.	E.A.	"	0.03 1.0	0.03 0.375	0.03 1.0 +c	0.03 0.375 —	0.03 1.0	0.03 0.375	0

As shown above, the types were principally aestivo-autumnal, and many of them were heavy infections. The cases were treated in the dispensary clinic for 2 days with the dosage indicated, and the rest of the medication was given them to take at home. They returned on the 3rd day, when another blood-examination was made; and the results thereof indicate clearly that the patients took their medicine faithfully.

After this examination the 36 patients then received their 3rd and 4th day treatments in the dispensary clinic, and were examined on the 5th day. Of these, 1 alone was found to be positive, making $94\frac{2}{5}\%$ apparently cured after 4 days of dispensary treatment.

These 36 cases were then given 2 more days of dispensary treatment with plasmochin and quinine, followed by tonic tablets.

Another series of cases was studied in order to determine the approximate efficiency of only half-doses of plasmochin compound. The results are shown in the following table, Series P, and are self-explanatory.

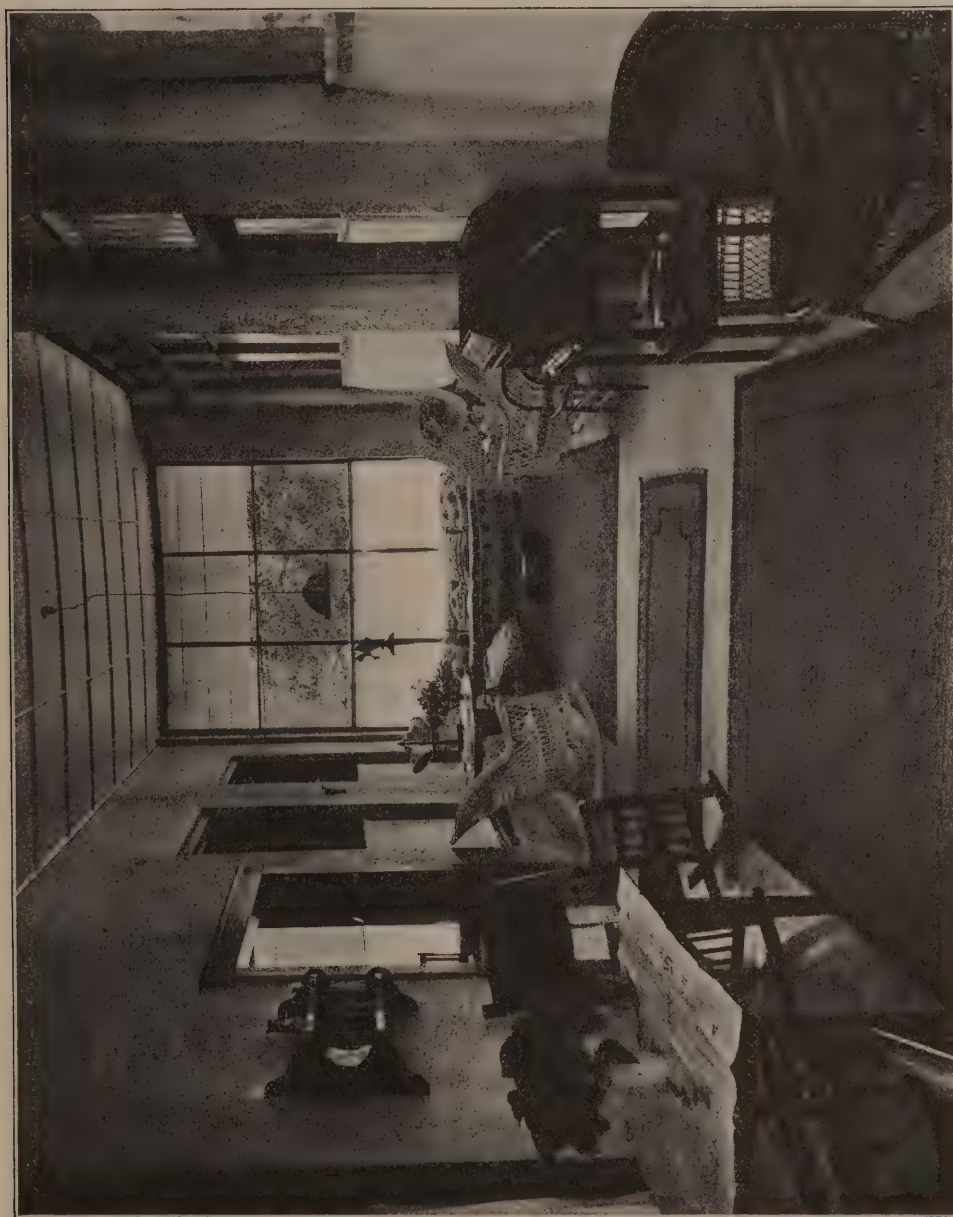


NURSES' HOME, EL PRADO, SANTA MARTA, COLOMBIAN DIVISION

Judging from this series, which is still too small for accurate determination, however, it appears that the half-dosage is not sufficient for moderately severe and resistant cases of malaria, and that in view of the excellent results obtained, without serious untoward effects, with the full dosage in both our hospital and dispensary series of cases, this latter method of treatment is to be preferred.

SERIES Q

In this, the concluding series, 35 positives were found in the survey made in Guabito by Dr. Barber and Mr. Komp. Twenty-nine of these applied for treatment; and after 2 days of medication with plasmochin compound, 9 were still positive, making 31% positive, or 69% that were apparently cured. After 2 more days of treatment with plasmochin compound, 2 cases alone remained positive. Therefore, after 4 days of treatment there were 93% of the 29 cases apparently cured.



INTERIOR VIEW OF PORCH, NURSES' HOME, SANTA MARTA, COLOMBIA

SOME OBSERVATIONS IN THE LIMON AND PANAMA DIVISIONS OF THE UNITED FRUIT COMPANY, WITH SPECIAL REFERENCE TO CERTAIN MEASURES FOR THE CONTROL OF MALARIA

December, 1927, to February, 1928

M. A. BARBER, SPECIAL EXPERT

W. H. W. KOMP, ASSOCIATE SANITARY ENGINEER

U. S. PUBLIC HEALTH SERVICE

A considerable portion of this work, especially the blood-parasite surveys, was done for the purpose of assisting Dr. Otto Brosius of Almirante Hospital, Panama Division, in his work on the plasmochin-quinine treatment of parasite-carriers. Dr. Brosius administered the plasmochin and quinine, and the details of the treatment and the results of some of the examinations of treated cases are found in his paper in another part of this Annual Report (see page 26). We have included a few of such results because they seemed to be of particular interest, or because they were obtained after the transmissal of Dr. Brosius' report.

I. MALARIA-PARASITE SURVEYS

In Table 1, page 55, appear the results of the primary malaria-parasite surveys of certain populations. This table does not include the results of reexaminations, and the numbers represent individuals. We have grouped under Nos. 1 to 5, inclusive (left-hand column), certain Company labor camps the population of which is almost wholly negro (West Indian). The other groups in this column include, for the most part, both Panamanians and negroes; and the Island groups, Nos. 11, 12 and 13, are wholly outside of the Company's territory. These, as well as some other groups, are included as a part of a study of the availability of certain antilarval measures in the control of malaria in the Tropics.

In Table 2, page 56, we have reassembled the cases shown in Table 1 and arranged them according to certain age groups.

We used thick films, Giemsa stain, for all blood preparations made in these surveys, occasionally employing thin films for confirmation. We examined 100 fields as a minimum, and more often 125 to 150 fields, before declaring a specimen negative. The first detection of a parasite occurred so rarely above 75 fields that any percentage of error due to the shortening of the time of search must have been very small, especially since the preparations were uniformly excellent. We examined all the specimens ourselves.

It appears, in Tables 1 and 2, that the children's parasite rate is usually much higher than that of adults,—uniformly so if we include under "children" the ages 13 and 14. If, in Table 1, we group together Nos. 1 to 6, inclusive, i.e., all Company labor camps, we have an adult rate of 13 per cent, and for children 12

TABLE 1
MALARIA PARASITE SURVEYS, PANAMA DIVISION AND VICINITY
JANUARY-FEBRUARY, 1928

No.	Locality	Children 12 Years and Under			Adults			Totals		
		No. Ex'd	No. Pos.	Per Cent Pos.	No. Ex'd	No. Pos.	Per Cent Pos.	No. Ex'd	No. Pos.	Per Cent Pos.
1	One-Mile Camp . . .	127	20	15.7	280	15	5.3	407	35	8.6
2	Dos Caños	41	23	56.0	62	19	30.6	103	42	40.8
3	Base Line	69	19	27.5	75	14	18.6	144	33	22.9
4	Field	10	4	40.0	30	8	26.6	40	12	30.0
5	Margarita	7	3	42.8	26	4	15.4	33	7	21.2
Total Company West Indian Labor Camps . . .		254	69	27.2	473	60	12.7	727	129	17.7
6	Chiriquicito	28	15	53.6	5	2	40.0	33	17	51.5
7	Guabito (Colored) . . .	83	22	26.5	102	28	27.4	185	50	27.0
8	Almirante	99	4	4.0	1	0	0.0	100	4	4.0
9	Chiriqui Grande	12	0	0.0	0	0	0.0	12	0	0.0
10	Guabito (White)	16	0	0.0	4	1	25.0	20	1	5.0
11	Bocas del Toro	148	54	36.5	31	8	25.8	190*	62	35.3
12	Careening Cay	47	23	48.9	35	8	22.9	82	31	37.8
13	Old Bank	67	20	30.0	33	13	39.3	100	33	33.0
Grand Total		754	207	27.4	684	120	17.5	1,449	327	22.9

* Eleven persons, ages unknown, appear in the totals only.

years and under, 29.8 per cent. The juvenile rate is so high in some camps that it is probable that nearly every person suffers from malaria at some time before the 15th year.

Evidently it is impossible justly to compare one group with another, or the rates of a given group examined at different times, without taking into account the proportion of children found in each survey. Where sufficient children are examined, it is convenient to consider their rate only in judging the amount of endemic malaria.

It is seen in Table 2 that high rates persist through the 15th year. It might have been more in accordance with infection rates to include under "children" in Table 1 the ages up to 15; but we have adopted the more usual classification, and in this report the term "children" will include only persons of the ages 1 to 12, inclusive.

Among positives the children showed parasites in larger numbers than adults. In 43 per cent of the children's cases we found one or more parasites per thick-film field, while in adults we found only 25 per cent with such numbers. With

TABLE 2
INCIDENCE OF PARASITES ACCORDING TO AGE

Age	Number Examined	Number Positive	Per Cent Positive
1	35	3	8.6
2	39	4	10.2
3	43	11	25.6
4	37	4	10.8
5	48	10	20.8
6	64	16	25.0
7	87	28	32.2
8	72	23	32.0
9	63	14	22.0
10	75	28	37.3
11	76	27	35.5
12	72	25	34.9
Total, 1-12 Years	711	193	27.1
13	57	17	30.0
14	49	16	32.6
15	21	9	42.9
Total, 13-15 Years	127	42	33.1
Total, 1-15 Years	838	235	28.0
Men, 16 Years and Over . . .	279	39	14.0
Women, 16 Years and Over . .	272	36	13.2
Both Sexes, 16 Years and Over .	551	75	13.6
Both Sexes, 13 Years and Over .	678	117	17.2

every type of parasite the children showed the higher percentage of heavier infections.

The men's parasite rate is listed (Table 2) separately from the women's, in order to give a basis of comparison with rates obtained among other groups of West Indian negro labor. Some authors have reported that in certain parts of Africa malaria among negroes is almost wholly a children's disease. Evidently such age incidence of the disease does not hold with negroes in Haiti or Central America, where the parasite rate of adults is considerable and adult negroes often suffer from clinical attacks of the disease.

We found in the 327 positive cases the following types of parasite: Aestivo-autumnal, 79 per cent; benign tertian, 9.1 per cent; quartan, 11.9 per cent. There was rarely any difficulty in distinguishing tertian and quartan in the thick films. We detected only one or two mixed infections, although there were probably many more present. A large proportion of the specimens showed rings only.

II. RELIABILITY OF PARASITE SURVEYS AS A MEANS OF DETECTING PARASITE-CARRIERS

We resurveyed two groups for the purpose of comparing the results of two different surveys made at short intervals. We hoped thereby to get some idea of the proportion of carriers likely to be missed by a single survey, an important matter where a survey is used as a basis for the treatment of a community. We made a blood-parasite survey of One-Mile Camp on January 12, 1928, and again 10 days later. This community has a relatively low parasite index (see Table 1, page 55). Positives obtained at the first examination were treated, and therefore do not enter into this comparison. We surveyed Field January 19, 1928, and again 22 days later. This community has a relatively high parasite index, and no cases were treated until after the second survey.

The results appear in the following summary:

	Results among Persons Examined at Second Survey	
	One-Mile Camp	Field
Persons Positive at First Survey	Treated	5 pos. out of 5 examined; all with same type of parasite
“ Negative “ “ “	2 pos. out of 72 examined	3 pos. out of 15 examined
“ not present “ “ “		
Examined Only at Second Survey	2 pos. “ “ 69 “	3 pos. “ “ 15 “

It appears from this comparison that the 5 positive at first examination (Field) remained positive, and that the proportion of positives among former negatives (both groups) was about as great as among people not previously examined. The series is a small one but, so far as it goes, it would indicate the desirability of repeated surveys where the object is to detect and treat the largest possible number of carriers. A single survey might detect many chronic carriers, such as we have found to exist in the southern United States.

III. INCIDENCE OF GAMETOCYTE-CARRIERS

We found crescents in greater or lesser numbers in 22 per cent of the 259 aestivo-autumnal cases. Children and adults showed the same proportion of crescents in these cases, 21.1 per cent and 22.4 per cent, respectively. The percentage of cases bearing benign tertian or quartan gametocytes detectible in thick films was small; about 2 in the 30 benign tertian cases, and none in the 39 quartan.

The percentage of crescent-carriers found in any survey, however, depends much on the time devoted to the search for rare crescents. A five-minute search of preparations containing aestivo-autumnal rings or the examination of two or

more films of aestivo-autumnal cases would materially increase the crescent percentage. Of much more importance is the percentage of cases likely to infect *Anopheles*. We found in all the primary surveys and reexaminations only 8 cases with gametocytes in sufficient numbers to afford good "prospects" for mosquito-infection work, 6 with crescents and 2 with benign-tertian gametocytes. Of these 8 heavier gametocyte-carriers, 5 were children and 3 adults.

The minimum number of gametocytes required to infect *Anopheles* is an uncertain matter, depending on the sex proportion of the gametocytes and on other factors, some of which are unknown. The number of gametocytes in a unit of blood affords a useful standard for comparison, but it would require a very large series of negative results to prove that a given number is below the threshold of infectibility, when we know that the oöcyst rate may vary from 0 to 50 in individuals of the same species of *Anopheles* which have fed but once on a given carrier. Our estimate of only 8 good "prospects" is based on a long experience in mosquito-infection work, and, lacking a definite standard, is of course subject to error. But our estimate receives some confirmation from the fact that the dissection of 258 *Anopheles* caught in the wild state revealed not a single specimen with either mid-gut or gland infection. These were collected during these surveys and, for the most part, came from dwellings in neighborhoods where light crescent-carriers were undoubtedly present. Certainly the number of potential mosquito-infectors found in these blood-parasite surveys was small, much smaller than we have found in certain other localities. Chiriquicito in the present survey proved an exception to the general rule, in that 3 "prospects" were found among 33 positives. This group, consisting largely of children of mixed races, was the most heavily infected of any group examined.

The rarity of potential mosquito-infectors found at any one survey has an important bearing on the use of plasmochin or of any other treatment designed primarily to destroy gametocytes. In the general survey of One-Mile Camp, for example, not one probable infector was found among the 35 parasite-carriers. If our criterion of a probable infector is correct, it is evident that the value of a single course of treatment in such a group would depend on a permanent cure or a lasting reduction in parasite numbers, rather than on the destruction of the few gametocytes present at the survey; for we know (see Case No. 2, Section V of this report) that cases may relapse soon after plasmochin-quinine treatment, and may become dangerous carriers. Follow-up surveys, the detection and treatment of relapsed cases, and the wide-spread use of the drug would seem to be indicated if plasmochin is to be most effective as a gametocyte-destroyer.

It is our opinion, based on a considerable experience in blood-parasite surveys, in the testing of gametocyte-carriers by mosquito-infection experiments, and in the dissection of *Anopheles* caught in dwellings, that it is the occasional heavy carrier which is most dangerous to a community.

IV. EXAMINATION OF CASES AFTER PLASMOCHIN-QUININE TREATMENT

The diminution of parasites during treatment and the number of cases remaining positive at its close are discussed by Dr. Brosius in another part of this Annual Report (see page 26). We shall mention here only 2 or 3 observations. One case, an Indian youth, showed no diminution in the number of aestivo-autumnal rings after 2 days' treatment. After 4 days' treatment the rings had largely disappeared and crescents appeared in the blood. In a few other cases crescents increased during treatment. In 1 case (Case No. 4, Section V) crescents appeared after 1 or 2 days' treatment in such numbers as to make the carrier a good "prospect" for mosquito-infection work, but mosquitoes fed on this case showed no oöcysts. This case before treatment showed only rings in large numbers. In no case did enough crescents appear at the end of a full 6 days' treatment to make the individual a good potential infector of mosquitoes. Of those which had received a full 4 days' treatment, only 1 showed rings in considerable numbers.

The results of the examination of treated cases 2 to 3 weeks after treatment are of interest since they have to do with possible relapse—the period being so short that reinfection seems unlikely. We reexamined two such groups: One-Mile Camp 22 days, and Dos Caños 13 days, after the close of a 6-day treatment with plasmochin and quinine. In One-Mile Camp only 2 out of 23 cases reexamined showed parasites in the blood. One case, an adult, showed crescents in small numbers, and the other case, a negro child of 2½ years (Case No. 2, Section V) had numerous crescents and aestivo-autumnal rings. The latter case had presumably relapsed, because she showed no parasites immediately after the close of the treatment. The crescents in this case were increasing, as shown by a second reexamination made soon after the first. They were then far more numerous than in any case we encountered in our surveys—nearly 200 per 1,000 leucocytes and approximately 1,600 per cubic millimeter of blood. The crescents proved capable of infecting anopheles in the laboratory. The patient showed no marked clinical symptoms, and probably her infection would have escaped detection but for the reexamination of the treated cases.

In the Dos Caños group, reexamined 13 days after treatment, we found among 38 cases only 2 positives, both with aestivo-autumnal rings.

The results of the examination of treated cases several months after treatment may show evidence of reinfection, as well as of relapse. We reexamined 3 such groups. In Gaubito we found 9 cases, all children, treated 5 months previously, and found 2 positive, both with aestivo-autumnal rings. In Base Line we reexamined 13 cases, all children, 5 months after treatment, and found only 1 positive, that one with quartan rings. In Field we reexamined 7 cases about 6 months after treatment and found 6 positive, 2 adults and 4 children, all with aestivo-autumnal parasites.

Summarizing these 3 groups, we have 9 positive out of 29 reexamined, a rate of 31 per cent. The general parasite rate of these 3 communities during January-February, 1928, will be found in Table 1, page 55, and may give some idea of the probabilities of reinfection in these groups. A more exact estimate of the results of treatment could be obtained by comparing positives treated 5 months previously with positives not treated, but we did not have enough cases of positives not treated to give a valid basis for comparison.

V. THE VIABILITY OF GAMETOCYTES IN THE BLOOD OF PLASMOCHIN-TREATED PATIENTS

It is well known that gametocytes may remain viable in spite of a vigorous quinine treatment. The following mosquito-infection experiments were done to test the viability of gametocytes present in cases receiving plasmochin-quinine treatment.

Case No. 1, B.C., Negro 14 Years of Age

Before treatment, there were crescents 26 per 1,000 leucocytes. *A. albimanus*, bred out from pupae in the laboratory; these were fed once on this patient and engorged specimens separated. During the 1st week after feeding on the patient, these mosquitoes were nourished on healthy human blood and subsequently on guinea-pig blood. Out of 13 dissected, 7 to 16 days after feeding on the carrier, 10 showed oöcysts in the mid-gut, their number varying from 3 to about 50 per positive gut. In 1, sporozoites were found in the salivary glands after 16 days.

After treatment for 2 days, 6 cg. plasmochin and 75 cg. quinine daily,¹ the crescents had diminished to 8 per 1,000 leucocytes. A fresh batch of laboratory-bred *A. albimanus* was fed on the patient. These were also subsequently nourished on healthy human, and on guinea-pig, blood. Of 6 mosquitoes dissected, all were negative. One of these was dissected 3 days after feeding on the patient, the others 8—11 days after feeding.

Case No. 2, M.S., Negro Child of 2½ Years

Before treatment, 196 crescents per 1,000 leucocytes, approximately 1,600 per cubic millimeter of blood (estimate based on a blood count made 2 days subsequently). Aestivo-autumnal rings were abundant. *A. albimanus*, laboratory-bred, were fed on the patient; 10 out of 14 mosquitoes dissected showed oöcysts in the mid-gut, their number varying from 5 to 30 per positive gut.

After treatment, 2 days, 0.015 gm. plasmochin and 0.33 gm. quinine daily, the number of crescents had fallen to 90 per 1,000 leucocytes, or 756 per cubic millimeter of blood (blood count made on same day). Aestivo-autumnal rings were still abundant. *A. albimanus*, 4 caught adult stage, the rest laboratory-bred, were fed on the patient, and subsequently nourished on healthy human blood.

1. One dose of plasmochin plus quinine was administered to the patient at the hospital, and the rest was given to him or his parents for him to take at home.

Of 12 dissected, all were negative. Three were dissected 3 days, one 6 days, and eight 9 days, after feeding on the patients.

Case No. 3, Mr. B., White Adult

Benign tertian parasites were very numerous. Estimated, 100 gametocytes per 1,000 leucocytes. The gametocyte count, done in the thin film, was perhaps less certain on account of the modification of the parasites through previous treatment but, on the basis of our previous experience, this patient would be regarded as an excellent "prospect" for infecting mosquitoes.

At the time of the first feeding of mosquitoes, the patient had received 1 day's treatment, consisting of 6 cg. plasmochin and 175 cg. quinine.² *A. albimani*, bred in the laboratory, were fed on this patient, and engorged specimens were separated. They were subsequently nourished on healthy human blood. Six days after feeding on the patient, 11 were dissected and all proved to be negative.

Case No. 4, R.E., Adult Negro

Crescents, 26 per 1,000 leucocytes. At the time of the first feeding of mosquitoes, the patient had received 2 cg. of plasmochin and 58 cg. of quinine.¹ *A. albimanus*, caught in the adult stage, were fed on this patient, and the blood-engorged specimens were separated. Seven were dissected, one 3 days, the rest 5 days, after feeding on the patient. All were negative.

All mosquitoes were kept at room temperature, that of the Tropics at sea level. The plasmochin and quinine were administered by Dr. Brosius.

These mosquito-infection experiments were begun for another purpose, but the failure of certain gametocyte-carriers, apparently excellent infectors, to infect mosquitoes after a short plasmochin-quinine treatment was so striking that we undertook further tests for the purpose of testing the viability of gametocytes not yet eliminated from the blood of treated carriers. To one familiar with the variability in the mosquito-infecting power of gametocyte-carriers, this short series of experiments is by no means conclusive; but the results are more than suggestive, and a larger series is planned with controls and varying dosage of plasmochin-quinine.

The matter is of no small importance in the possible control of malaria by treatment. Should it prove that small doses of plasmochin may so cripple gametocytes, or so far interfere with their normal development, as the case may be, that they are rendered incapable of forming healthy oöcysts, the usefulness of plasmochin, or plasmochin combined with quinine, could be greatly extended. For it would seem that this drug must be widely used if it is to be effective in destroying gametocytes, at least in highly-infected regions; and the smaller the dosage necessary, the safer and more useful this method of treatment would be.

1. One dose of plasmochin plus quinine was administered to the patient at the hospital, and the rest was given to him or his parents for him to take at home.

2. Patient treated at the hospital.

The work of Dr. Brosius in demonstrating that plasmochin, combined with quinine and employed in limited dosage, may be safely distributed in a population and taken without the immediate supervision of a physician, has laid the foundation for the most effective use of this new drug.

VI. INCIDENCE OF ADULT ANOPHELES IN HOUSES—DISSECTION, AND EXAMINATION FOR MALARIA PARASITES, OF ANOPHELES CAUGHT IN THE ADULT STAGE

Approximately 162 laborers' houses—i.e., the larger proportion in the Limon Division—were searched for adult Anopheles. The number per dwelling varied greatly—often not one could be found in a whole row of houses, even in a highly malarious locality; in other cases, as many as 25 were found in a single room. Numbers varied greatly from time to time. In one camp (Toro Spur, Limon Division) an average of 4 to 5 per house, with a maximum of 25, was found at one visit and almost none at the next. It seems probable that *A. albimanus* often flies to the jungle after feeding on persons in dwellings, for we sometimes found considerable numbers entrapped in bed nets (in one case, 13), while none could be found on the walls of the house.

Of the Anopheles caught in houses, those identified belonged to the following species: *A. albimanus*, 313; *A. vestitipennis*, 18; *A. punctimacula*, 1; *A. pseudopunctipennis*, 1 male. This list includes many caught in non-company dwellings. In one of these, situated about $\frac{3}{4}$ of a mile from One-Mile Camp, we found from 35 to 39 in a single house on 3 different occasions.

The numbers found under houses were remarkably small, although many such places afforded apparently good resting places.

We dissected for malaria parasites 258, of which 248 were *A. albimanus*, 9 *A. vestitipennis* and 1 *A. punctimacula*, practically all found inside inhabited houses. We examined both mid-gut and salivary glands in 174 of these, mid-gut only in 66, and salivary glands only in 18. In no case did we find an infected specimen. These findings are by no means unusual. One will often dissect many Anopheles caught in highly malarious regions without finding a single positive—then, perhaps, find several in one house.

In our house visits we kept a record of the number of persons found sick in bed. Only 4 were found in the whole series, and 1 of these was probably ill of some disease other than malaria.

OBSERVATIONS ON THE TOXIC EFFECT OF PLASMOCHIN

WILHELM CORDES, M.D.

United Fruit Company Hospital

Preston, Cuba

Our experience with plasmochin extends over two years and includes the treatment of about 250 patients. Practically all of them were male adults

of the African race, suffering from E. A. malaria. In the initial treatments 8 centigrams of plasmochin were given daily, in combination with quinine; but later on, warned by the untoward effects of the medication, we reduced the dosage to 6 and then to 4, centigrams. Our routine hospital treatment is now 2 pills of plasmochin compound, plus 10 grains of quinine, twice daily; i.e., a total daily amount of 4 centigrams of plasmochin and 1.8 grams of quinine.

We have not found that the addition of plasmochin to the medication changes the course of the febrile symptoms. Ring forms did not disappear more rapidly than under the old method of treatment with quinine alone. The effect of plasmochin on the crescents which were present in the peripheral blood, however, was evident; and our observations, published in the 1926 Annual Medical Report, were confirmed. We saw 3 more carriers with 5 or more crescents to one field, in which the peripheral blood became negative after 4 to 6 days of plasmochin medication. Occasionally, crescents, in very limited number, persisted up to 10 days—especially when treatment was with the reduced dosage of 4 centigrams. We observed several times that the disappearance of crescents was accompanied by an increased basophilia of red-blood corpuscles.

Several incidents directed our special attention to the toxic effects of plasmochin. *Mühlens*, in a recent review of the subject of plasmochin treatment and its complications, based on his original experience and the literature published so far, pointed out that in some cases plasmochin produces cramp-like abdominal pains and cyanosis. Contrary to ideas expressed in previous publications, he admits that the pale grayish-blue discoloration of certain patients is caused by true methaemoglobinaemia, in the course of which the serum may become chocolate-colored. Consequently, we have to deal with a so-called false cyanosis, due to the presence of abnormal pigment, such as methaemoglobin—and not with a cyanosis caused by deficiency of oxygen, similar to that encountered in cardiac patients.

We have on record 6 cases of serious disturbances, 2 of them with fatal results; and do not hesitate to attribute them to plasmochin intoxication, although the pharmacological action of the drug does not yet seem well determined. It must be stated that the great majority of patients, including those with heavy infections and in poor general condition, tolerate plasmochin perfectly well; whereas in occasional cases, without previous warning, very grave symptoms arise. We do not remember having seen such symptoms in malaria patients treated by our former methods; it is only since we have used plasmochin that these accidents have repeatedly occurred with striking similarity.

Of the 6 cases, 4 occurred when we gave 8 centigrams of plasmochin daily. They are reported in detail elsewhere (*Cordes*), and may be summarized as follows:

On the 4th or 5th plasmochin day, when acute symptoms of malaria had subsided and the blood was free of ring forms, the patients suddenly developed prostration and somnolence, accompanied by pains in the epigastric region

and vomiting. There was a slight rise of temperature for 1 or 2 days. The skin and mucous membranes turned pale and became jaundiced. The haemoglobin dropped appreciably, the erythrocytes showed macrocytic and microcytic forms; while polychromatophilia and basophilia, and also numerous nucleated red cells, appeared. The presence of free haemoglobin or methaemoglobin in blood and serum could not be controlled spectroscopically. The leucocytes increased in number, reaching 24,000 to 32,000; and the irregularities of the differential count were of a most unusual character. A degenerative, and at the same time highly regenerative, leucocytosis was evident, which involved especially the granulocytic group. Many atypical juvenile forms were seen, such as are mobilized from the bone marrow in severe toxic anaemias and some cases of blackwater fever. The urine contained slight amounts of albumin, casts, and bile; and gave a strongly positive urobilinogen test. The excretion of blood was never observed. Two patients died, in deep coma, within 48 hours after the onset of symptoms. The autopsy in one of these cases revealed malarial infection (spleen); marked phagocytosis of red-blood corpuscles in the spleen; and an early stage of central necrosis of liver lobules.*

Another instance of intoxication was seen in Haiti, during the recruiting of laborers under dispensary conditions:

A negro man aged 45 years, in good general condition, with a haemoglobin content of 60%, who was a crescent-carrier, was given 4 centigrams of plasmochin daily, in the form of plasmochin compound, administered in 2 doses. After 5 days of treatment, he felt badly, was dizzy, and vomited. He was pale and jaundiced. The thick-blood film showed very marked basophilia of erythrocytes, and strong polynuclear leucocytosis, estimated as between 20,000 and 25,000. The haemoglobin came down to 35%. The urine did not contain blood. The patient recovered within a week.

The last case came under observation recently in this hospital, also after administration of the reduced dosage of 4 centigrams of plasmochin daily:

A. F., aged 22 years, colored Haitian, was admitted to the hospital on February 14, 1928; he complained of having had fever and headache for 3 days. His general condition was good; temperature 102° F.; spleen and liver not palpable. Scars in tibial regions, epitrochlear glands enlarged (patient had had framboesia when a child). Blood: Haemoglobin 60%, thick-blood film showed aestivo-autumnal rings.

The patient was put on routine malaria treatment on February 15. The urine contained albumin and granular casts; the stools, eggs of ascaris; and the Meinicke test was strongly positive. The patient had another chill and a rise in temperature during the evening. *February 16*, fever continued, and he complained of severe headache. *February 17*, patient complained of having felt badly and very weak for the past 12 hours. Had epigastric pains (no vomiting). The sclerae were jaundiced; mucous membranes pale; spleen and liver not enlarged. Temperature 99° F. Treatment was discontinued. The patient had taken within the past 3 days a total of 12 centigrams of plasmochin, plus 5.5 grams of quinine. Haemoglobin was 35%; thick-blood film showed

* Autopsy findings were given in the 1926 Annual Medical Report.

strong basophilia and leucocytosis; and 2 crescents were found. Thin film showed oligocytosis, anisocytosis, basophilia of erythrocytes, numerous normoblasts, and a few megaloblasts. W. B. C. 24,000, differential count:

	%
Eosinophiles	3.5
Myelocytes	4.0
Young polynuclears	25.0
Staff nuclears	27.5
Polynuclears	23.0
Lymphocytes	13.0
Mononuclears	4.0

There were a few atypical cells which could not be classified, also many torn leucocytes, most of which seemed to belong to the granulocytic group. The blood (taken from the vein, about 12 hours after the onset of symptoms) was of chocolate-brown color. Before the coagulation was completed (after 10 minutes), the erythrocytes had sedimented down. The serum was quite clear, of dark-yellow color (bile), but did not contain any free blood pigment visible to the naked eye. Urine showed specific gravity of 1.022, reaction strongly acid, moderate amount of albumin and casts, traces of bile, urobilinogen test strongly positive, and benzdene test for haemoglobin negative.

February 18, condition unchanged. Temperature between 99° and 101° F. Urine, total amount for 24 hours 900 cc.; no blood. *February 20*, patient felt better; temperature normal; thick-blood film negative for parasites; W. B. C. 20,500; differential count:

	%
Eosinophiles	3.0
Myelocytes	1.0
Young polynuclears	7.5
Staff nuclears	19.5
Polynuclears	30.5
Lymphocytes	32.5
Mononuclears	6.5

February 23, general condition much improved; slight jaundice still present; haemoglobin, 40%. The course from then on was favorable.

The last two cases typify the symptomatology of plasmochin intoxication as I have seen it. They further prove to us that even small doses, of 4 centigrams, do not always prevent alarming complications. *Mühlens* has recently recommended, as a safe dosage, to give 1 centigram of plasmochin per 10 kilograms of body weight. This limit was certainly not exceeded in the last-mentioned cases. *Mühlens* further advises to discontinue plasmochin with the slightest evidence of cyanosis or gastric distress. We were always impressed by the fact that, with the onset of symptoms, intoxication was already fully established and destruction of red cells had taken place. A slight shade of cyanosis as a sign of warning was of no avail in our black patients; neither were stomach pains complained of immediately after the taking of plasmochin.

To account for the fact that plasmochin, although tolerated well by most patients, sometimes causes symptoms of intoxication, one is tempted to think of an idiosyncrasy in certain persons. Or there may be an action of plasmochin which resembles that of quinine in provoking blackwater fever,

namely, it activates a hemolytic mechanism already prepared in a malaria-infected patient; it is, metaphorically, the match which sets the house on fire. The resulting blood destruction seems out of proportion to the amount of the drug administered, and in this respect plasmochin cannot probably be compared with other hemolytic agents like phenacetin or antifebrin. Also, the jaundice, which we observed in all cases, seems proof that there is an abundance of free blood pigment in circulation, at least for a certain short period, which is changed by the liver into bilirubin.

The relations between plasmochin intoxication and true blackwater fever are manifold. Plasmochin causes a similar blood destruction and irritation of the hematopoietic system, connected with prostration, paleness and icterus. The onset is equally sudden and spectacular. Only the repeated rigors and rises in temperature are not so pronounced as in blackwater fever, and hemoglobinuria does not occur; at least not in our patients. There is, perhaps, a racial peculiarity, because it is generally known that blackwater fever with hemoglobinuria is extremely rare in colored people.

Manson-Bahr, who saw a case of plasmochin intoxication very similar to those above described, points out that the attack ran the course of a mild blackwater fever, and that the action of plasmochin may shed new light on the mechanism of this clinical syndrome.

For therapeutic as well as prophylactic purposes the toxic effect of plasmochin constitutes a lamentable drawback. The property of ridding crescent carriers of their parasites and consequently rendering them non-infectious for mosquitoes suggests the possibility of sanitating whole malaria districts by mass treatment of the population, especially under conditions, like those in the cane areas of Cuba, where scores of laborers live in open camps which can hardly be reached by successful anti-mosquito measures. But it does not seem safe to place plasmochin in the hands of dispensers or rural overseers for free distribution. Its administration requires a constant control of the patients which can be carried out effectively only in the hospital. In this respect, we find ourselves in agreement with the conclusions, of *Fletcher and Kanagarayer*. To obtain the full benefit of plasmochin in a malaria campaign, and evade its disadvantages, we recommend that heavy crescent carriers be selected by blood surveys and treated under medical supervision.

CONCLUSIONS

1. Among 250 patients treated with plasmochin, 6 cases of intoxication were observed, 2 of them with fatal issue.

2. 4 cases occurred after 8 centigrams, 2 after 4 centigrams of plasmochin daily.

3. Plasmochin causes destruction of red blood cells and irritation of the hematopoietic system, with clinical symptoms of prostration, paleness and jaundice.

4. Intoxication resembles in certain aspects blackwater fever.

5. Plasmochin should not be given without permanent medical control.

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PLASMOCHIN IN MALARIA

N. P. MACPHAIL, M.D.

United Fruit Company Hospital

Quirigua, Guatemala

During the past few months we have made a serious effort to determine the value of plasmochin in the treatment of malaria in all its forms, and the dosage necessary for maximum results. As referred to in the Fifteenth Annual Report, (1926), we had then found that plasmochin promised to be a very efficient agent in ridding the peripheral blood of gametocytes; and the cases treated up to that date, while small in number, gave uniform results. During the present year a much larger series of cases has been treated; and careful blood observations on all gametocyte-carriers have led us to believe that plasmochin is an especially efficient drug for the quick destruction of gametocytes.

Our first observations created the impression that, owing to the toxic symptoms which developed in a small percentage of cases, we should have to limit the use of plasmochin to hospital cases that could be kept under constant clinical observation. Since the report of our first experience, however, continued careful observation, under various methods of administration, leads us to believe that our original conclusions can be considerably modified. As a result of our more recent experience, we think that the field of usefulness of this drug can be safely extended, and that its use in our outdoor anti-malaria sanitary campaign is entirely justifiable. There appears to be little doubt that plasmochin should be administered in combination with quinine, which seems to diminish its toxic tendencies. This has been done in the cases treated and herewith recorded. Most important of all is the fact that the dosage of plasmochin originally recom-

mended can apparently be considerably reduced without interfering with its efficiency.

In a series of 500 cases which received a 6-day course of plasmochin in this hospital, there were 105 which had gametocytes in their peripheral blood at the time of admission. Over 400 of these cases were given .06 gm. daily, in doses of .02 gm. t.i.d. In this series 6 cases developed toxic symptoms while under treatment. Two developed slight symptoms on the 4th morning and 3 on the 5th. One was discharged after completion of the 6-day course; the following day he was slightly cyanosed, and complained of some gastro-intestinal distress. All 6 of these cases occurred in the first-class wards. In 3 cases, the abdominal distress and cyanosis lasted for 3 days; and in 2 cases, it lasted for 4 days. The only treatment given was rest in bed, with suspension of plasmochin treatment; and no serious consequences resulted in any case. As no case developed toxic symptoms in the 2nd-class wards, where quinine was routinely administered with plasmochin, it seems probable that cyanosis and gastro-intestinal distress are not so liable to develop when the combination treatment is given.

Our experience has not demonstrated that plasmochin is particularly efficacious in clearing the peripheral blood of the schizonts of *E. A. malaria*, and our routine procedure in all these cases is to administer a combination of plasmochin and quinine. The paramount value of plasmochin rests in its effectiveness in ridding the peripheral blood of gametocytes, thus rendering the treated individuals non-infective to mosquitoes. Clark has drawn attention to the persistence of gametes under prolonged and intensive quinine treatment. Our experience has coincided with his findings; and long after all acute symptoms have disappeared, and the patient is apparently cured, large numbers of gametes are frequently found in the peripheral blood.

In the series of 105 cases which had gametocytes present on admission, we found that in 104 of them the thick-film method did not reveal gametes in the peripheral blood on the 5th day. The exception was a heavy infection in a 10-year-old child, who had a severe nephritis, and to whom we gave .02 gm. of plasmochin daily. He was removed by his parents on the 7th day, and still showed *E. A.* crescents in his peripheral blood.

In several of our cases, receiving quinine only in doses of from 30 to 40 grains daily, we have found that gametes were still present after 20 days; and, in 1 case, after 23 days of continuous treatment. An important point to determine was the minimum effective dose. To begin with, we gave as high as .12 gm. daily; but, in the light of our more recent experience, we believe this dose is unnecessarily large. We have had excellent results following the administration of .06 gm. daily; and for the past month we have given, to a certain number of gamete-carriers, .03 gm. of plasmochin combined with the same amount of quinine as in the other series. The results obtained, up to the present, with this latter dosage encourage us to believe that it may prove to be as effective as the larger dosage. In 11 cases of gamete-carriers treated with .03 gm. daily, we have found that no gamet-

ocytes have been demonstrable after the 4th day; and when this dosage is administered, no toxic symptoms are observed.

The tablets originally prepared contained .01 gm. of plasmochin and .125 gm. of quinine. I think that our experiences with over 500 cases have demonstrated that 6 of these tablets can be safely given daily, to adults, over a period of 5 or 6 days. If slight gastro-intestinal distress, or cyanosis, appears in any case under treatment, suspension of treatment is indicated; and no serious results follow if the treatment is stopped. In all acute cases, plasmochin should be supplemented with extra quinine, as we have reached the conclusion that the amount of quinine in the *compound plasmochin tablets* is not sufficient to control acute E. A. malaria promptly.

We are now extending the combined treatment to camp work, under the supervision of careful dispensers, and have begun this work with daily doses of .06 gm. plasmochin and 20 extra grains of quinine. A practical demonstration of the efficacy of this method of treatment on a large scale, is recommended. If successful, it will justify the conclusion that in plasmochin we have an agent which will prove of the greatest importance in malaria-control work. In our large plantations and extensive inhabited areas, malaria control through mosquito-destruction is practically impossible at present, and is a most expensive measure. We believe that if we find we can effectively control the malaria-carriers by curing them with plasmochin, our anti-malaria work will be simplified and can be carried on with a reasonable expenditure.

In the 5 cases which showed toxic phenomena, all had similar symptoms. The first complaints were of slight griping abdominal pain, which became more marked a few hours later. Slight cyanosis of the skin, lips, and nails appeared about the same time; and it became more evident some hours afterward, even though treatment had been promptly suspended after the appearance of the first signs of trouble. Anorexia was marked in all these cases, and all complained of feeling weak. The complete absence of toxic symptoms in the great majority of our cases would suggest that the individuals who developed symptoms have an idiosyncrasy for plasmochin which is probably more or less similar to the intolerance for quinine that we occasionally meet in practice. In the treatment of the cases in camps .04 gram of plasmochin and 1.33 grams of quinine sulphate have been given daily in 2 doses (morning and evening) for a period of 6 days, and no toxic or other untoward symptoms have been noted. In all the cases examined 2 days after the completion of the treatment, the bloods have been negative. Our experience justifies the conclusion that plasmochin in this dosage in combination with quinine, can be safely administered under very ordinary supervision.

CLINICAL RESULTS WITH PLASMOCHIN

B. M. PHELPS, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

The greatest difficulty was encountered, when we endeavored to determine the efficacy of plasmochin and plasmochin compound in the treatment of malaria cases among the native population, inasmuch as it is practically impossible to obtain a good "follow-up" of the cases. Furthermore, the majority of our native patients belong to the laboring class, and there was consequently a dearth of reliable history, as well as a lack of clear descriptions of symptoms. In addition, cyanosis was easily overlooked, owing to the dark complexions of the patients. For this reason, the case reports included in this paper are confined to the better class of patients, principally Americans and Europeans, who gave a more definite history and were able to describe accurately any symptoms of an abnormal character which might develop.

CASE No. 1

R. P., an elderly white man, was admitted to the hospital on April 12, 1927. He was very ill, and stated that he had had fever for 3 days but had taken no medicine. The thin-film examinations showed E.A. rings; and he was given 2 plasmochin compound tablets t.i.d. During the night of April 14 he had a chill, and his condition became so serious that the plasmochin compound was discontinued. Quinine dihydrochloride grs. 22½ was given intramuscularly, followed by quinine sulphate grs. 22 b.i.d. by mouth; and this dosage was later decreased in amount. On April 18 the blood showed crescents; but it was negative, in thick films, on April 19, 20, 21, and 22. The patient was discharged as cured on April 23, and was given the usual Pink Tonic Tablets as a "follow-up" treatment.

He was readmitted to the hospital on June 23. He had no fever, but appeared very sick and confused, and complained of indigestion. Tertian parasites were found in his blood. He was given 2 plasmochin compound tablets t.i.d. The blood became negative on June 25, and was negative daily up to and including June 29. The patient was discharged as cured on June 30, but was instructed to take the usual "follow up" treatment of Pink Tonic Tablets.

CASE No. 2

H. R. P. was admitted on June 21, 1927, with a history of fever, at intervals, for 2 weeks. Before he entered the hospital, he had taken 30 grs. of quinine during 1 day; 10 grs., 1 day; and 5 grs. daily for 3 days. The blood showed E.A. rings, and he was given 2 plasmochin-compound tablets t.i.d. The blood was negative on June 24, 25, 26, and 27; and he was then discharged. At this time his nails and lips were slightly blue. He was given 120 Pink Tonic Tablets, to take 2 b.i.d.

He was readmitted to the hospital on July 14, before he had completed the "follow-up" treatment prescribed. He had had a chill, fever, and headache the day before readmission. The blood contained E.A. rings, in thick and thin films. He was given 2 plasmochin-compound tablets t.i.d., and quinine sulphate grs. 10 b.i.d. The blood was negative on July 17, 18, and 19. On July 19, the patient's lips and nails began to show a bluish tint, and he complained of dull pain in the epigastrium. The dosage of plasmochin-compound tablets was then changed to 2 tablets b.i.d. The patient was discharged as cured on July 21. He has remained well; and the blood was negative when last examined.

CASE NO. 3

E. L. H. was admitted to the hospital on June 4, 1927, with a history of having had fever for 6 weeks. He stated that he had taken a considerable amount of quinine, but not regularly. The first 4 days of the week in which he was admitted, he took 10 grs. daily. The blood showed a mixed infection. He was given plasmochin-compound tablets, 2 t.i.d. The blood was negative on June 8, 9, 10, and 11. He was then discharged as cured, and instructed to take 2 Pink Tonic Pills b.i.d. There were no untoward results from the administration of plasmochin.

This patient was readmitted on October 31. He had had a headache for a week, and a chill followed by fever on the morning of admission. He had taken compound cathartic pills and salts, but no quinine. The blood showed a heavy tertian infection; and he was given quinine grs. 20 b.i.d. until November 2, when 2 plasmochin-compound tablets t.i.d. were added. The course of illness was uneventful, and his blood was negative on November 5 and 6. The patient was discharged as cured on November 7, and given Pink Tonic Pills as a "follow-up" treatment.

CASE NO. 4

J. A. B. was admitted on July 8, 1927, and stated that he had not felt well for about 1 month. He had had chills, fever, and headache for the 2 days immediately preceding admission. The patient had not taken any quinine during the month prior to admission. The blood showed a moderate infection with E.A. rings, and he was given 2 plasmochin-compound tablets t.i.d. On July 12 the patient was still feeling very ill; and, as there seemed to be no improvement in the blood findings, 10 grains of quinine sulphate b.i.d. were added to the medication. On July 14 the blood was negative, but the patient was very sick. He complained of severe pain in the epigastrium, with vomiting and headache; and these symptoms were accompanied by cyanosis. Plasmochin compound was discontinued; and quinine sulphate grs. 15 b.i.d. was given until the patient was discharged as cured on July 19. The cyanosis was still apparent, in the lips and nails. The blood had been negative on July 14, 15, 16, 17, and 18.

He was readmitted on November 5, with a history of having had chills and fever, on alternate days, for 1 week; and on the 3 days immediately preceding his admission he had taken 10, 20, and 30 grs. of quinine, respectively. The thick film showed a few tertian parasites. He was instructed to take 2 plasmochin-compound tablets, but refused this medication after the 1st dose on account of the serious reaction he had experienced during his previous treatment. Quinine sulphate grs. 20 b.i.d. was then given, and he was discharged on November 9, at his own request. The thick films were negative on November 8 and 9.

CASE NO. 5

A. J. F. was admitted on July 21, 1927. He stated that he had suffered from headache, fever, and vomiting for 1 week, but had taken no medicine. The blood films showed a heavy mixed infection. He was given 2 plasmochin-compound tablets t.i.d. The night following admission he was very ill and slightly delirious, and a hypodermic of quinine dihydrochloride grs. 22½ was administered intramuscularly. He was quite markedly improved by the evening of July 23; but on July 26 his temperature rose to 101° F., and he was very sick. The blood was still positive, and the quinine hypodermic was repeated. On July 29 the nails and lips began to show a bluish tinge. The plasmochin compound was discontinued, and he was given quinine sulphate grs. 10 b.i.d. The blood was negative on July 27, 28, 29, and 30, and the patient was discharged as cured on August 1. He promised to take 2 Pink Tonic Pills b.i.d., for 30 days.

He was readmitted on August 10, and stated that he had had diarrhoea for 4 days, but that he had had no fever since he left the hospital on August 1. The blood showed E.A. rings, in thick and thin films. He was given 2 tablets of plasmochin-compound t.i.d., and quinine sulphate grs. 10 t.i.d., until August 16, when the plasmochin compound was omitted on account of his previous indications of an idiosyncrasy for this drug. There was no diarrhoea after his admission to the hospital; and he was discharged as cured on August 18, after the blood thick-films had been negative on August 14, 15, 16, and 17. He has remained well since that date, and blood smears taken on October 9 were negative.

CASE NO. 6

J. K. was admitted on September 15, 1927. He had had fever, on alternate days, for 2 weeks, but had taken no medicine. The blood showed a light tertian infection. He was given quinine sulphate grs. 20 b.i.d. for 4 days, and then 2 plasmochin-compound tablets t.i.d. were administered until he was discharged as cured on September 20. The blood had been negative on September 17 and 19.

CASE NO. 7

O. Y. was admitted on August 26, 1927. He had had fever, headache, vomiting, and pain in the back every day for 18 days. The blood-examination showed E.A. rings and many crescents. He was given plasmochin-compound tablets t.i.d., with quinine sulphate grs. 10 b.i.d., for 5 days. The plasmochin-compound tablets were then omitted, and subsequently 2 plasmochin tablets b.i.d. and quinine sulphate grs. 15 b.i.d. were given. The crescents persisted until September 2. The thick films were negative on September 3 and 4, and the patient was discharged on September 5. He left the division, and consequently no further records are available.

CASE NO. 8

R. S. was admitted on July 31, 1927. He had had pains in the back and bladder for 1 month, but had taken no medicine. The thick film showed a light E.A. infection. He was given 2 plasmochin tablets, 4 times daily; and also 3 doses, 1½ grs. each, of sodium cacodylate, hypodermically. The thick films were negative on August 2, 3, and 4; and the patient was discharged as cured on August 5, 1927. On November 9 he stated that he had not had any return of symptoms.

CASE No. 9

L. P. H. was admitted on July 29, 1927, suffering from fever. He had taken no quinine. The blood showed a moderate number of E.A. rings. He was given 2 plasmochin-compound tablets t.i.d., and quinine grs. 10 b.i.d. On the morning of August 1 the quantity of plasmochin compound was increased to 2 tablets, 4 times daily. That night the patient complained of a slight, but constant, pain in the epigastrium; and the following day the pain was more severe. On August 3 cyanosis was marked, especially in the lips and nails, and the plasmochin compound was discontinued. On August 8 slight cyanosis was still present, but the pain had disappeared. Thick films were negative on August 1, 2, 3, 4, 5, and 6; and the patient was discharged as cured on August 8, with instructions to take 120 Pink Tonic Pills as a "follow-up" treatment.

This patient was readmitted the latter part of October, for treatment of an injury. His blood was then negative, and he stated that he had been well since he left the hospital on August 8.

CASE No. 10

J. S. H. was admitted on August 7, 1927, and stated that he had had chills and fever and had vomited, for 2 days. He had taken a dose of salts and 30 grs. of quinine the day before he was admitted, and 60 grs. of quinine on the date of admission. The blood showed a mild tertian infection. He was given 2 plasmochin-compound tablets t.i.d., and quinine grs. 10 b.i.d. On August 12 he complained of pain in the epigastrium, and the plasmochin-compound was discontinued. On August 13 the cyanosis was quite noticeable, but the pain was less. The blood was negative on August 10, 11, 12, 13, and 14, by thick-film examinations. The patient was discharged as cured on August 15, and he has remained well since that date.

CASE No. 11

V. G. G. was admitted August 11, 1927, and complained of fever, chills, and headache. He had taken a 5-gr. tablet of quinine t.i.d., for 3 days. The blood showed a moderate mixed infection. He was given 2 plasmochin-compound tablets t.i.d., and quinine grs. 10 b.i.d. On August 18 he complained of pain in the epigastrium; and on August 20 he developed cyanosis. The plasmochin compound was then discontinued. The thick films were negative on August 16, 17, 18 and 19. He was discharged as cured on August 21. The patient has remained well since that date.

CASE No. 12

L. E. D. was admitted to the hospital on August 18, 1927, suffering from fever, chills, and headache. For 3 days he had taken quinine grs. 15 b.i.d. He was given 2 plasmochin-compound tablets t.i.d., and quinine grs. 10 b.i.d. On August 24 he complained of pain in the stomach, and vomited. The plasmochin-compound tablets were discontinued. The thick films were negative on August 22, 23, and 24, and he was discharged on August 25. He has remained well since that date.

CASE No. 13

H. P. was admitted to the hospital on July 5, 1927, with a history of having had fever and chills, at intervals, for the preceding 3 weeks. He had taken $\frac{1}{2}$ pint of liquid quinine, in tablespoonful doses t.i.d. The blood showed light E.A. infection. He was given 2 plasmochin-compound tablets t.i.d., and quinine grs. 10 b.i.d. The blood was negative on July 7, 8, and 9; and he was discharged as cured on July 10.

CASE No. 14

L. L. was admitted to the hospital on July 31, 1927. He had had fever and headache for 2 weeks, but had taken no medicine. He was very ill, and his blood showed a light E.A. infection. The patient was given 2 plasmochin compound tablets 4 times daily, and quinine grs. 10 b.i.d. On August 3 he complained of constant and severe pain in the epigastrium, and vomited. On August 4 there was marked cyanosis, with less pain but frequent vomiting; and the plasmochin compound was discontinued. On August 5 the pain was noticeably less, and he vomited only once. Improvement continued until he was discharged as cured on August 9, after thick films were negative on the 3, 4, 5, 6, and 7. He has had no recurrence up to the present date.

CASE No. 15

J. L. P. was admitted on July 11, 1927. He complained of headache, and of aching in all parts of the body; and he appeared to be very sick. He had taken no medicine. The blood showed a heavy E.A. infection, and he was given 2 plasmochin-compound tablets t.i.d., and quinine grs. 10 b.i.d. Vomiting continued at intervals, for 5 days; and on July 18 slight cyanosis was noted. The plasmochin compound was discontinued on July 19. The thick films were negative on July 17, 18, 19, 20, 21, 22, and 23; and he was discharged as cured on July 24th. There has been no recurrence of the disease.

CASE No. 16

E. H. was admitted on May 5, 1927, with a history of fever and headache on the day before admission. He had had a severe attack of malaria, in Guatemala, 2 months previously. The blood showed a light E.A. infection, but he did not appear very ill. He was given 2 plasmochin-compound tablets t.i.d. The thick films were negative on May 7, 8, 9, and 10; and the patient was discharged as cured on May 11. He has remained well up to the present date.

CASE No. 17

S. T. H. was admitted May 11, 1927. He had had fever and chills, mostly at night, and obstinate constipation; but had taken no medicine. The thick film was negative on admission, and the temperature remained normal for 7 days. The thick film on May 18 showed plus tertian infection. He was given 2 plasmochin-compound tablets b.i.d. On May 20, gametes were found in the blood. The blood became negative on May 24; and daily thick films were negative up to the date of his discharge, on May 29. On May 25 and 26 slight cyanosis was noted, but there was no complaint of pain. On May 27 the plasmochin compound was discontinued. No blood-examinations have been made recently, but he has remained well.

CASE No. 18

A. C. was admitted on June 11, 1927. He had had fever and chills, and some attacks of vomiting, for 4 days; and had taken a dose of salts, and 15 grs. of quinine—both of which were vomited. He had been in the hospital in March, 1927, suffering from an attack of fever. The blood smear showed double-plus tertian infection, and the patient was given 2 plasmochin-compound tablets t.i.d. He complained of severe epigastric pains on the afternoon of the day of admission and all of the following day; but the pain was probably not caused by the plasmochin, and the drug was continued. Slight cyanosis was noted on June 16, but there was no pain at that time. The thick films were negative on June 14, 15 and 16, and the patient was discharged as cured on June 17. He has remained well up to the present time.

CASE No. 19

D. G. P. was admitted on May 21, 1927. He had had attacks of dizziness, pains in the stomach, and too frequent stools, but had taken no medicine. The thick film showed a light E.A. infection, and he was given 2 plasmochin-compound tablets t.i.d. The blood was negative on May 26, 27, and 28; and the patient was discharged as cured on May 29. No unpleasant symptoms developed during the course of treatment or subsequently, and he has remained well up to the present time.

SUMMARY

Nineteen cases, treated wholly or in part with plasmochin or plasmochin compound, are cited. Of these cases, 11 showed some undesirable reaction to this drug. The toxic symptoms in some patients were so mild in character as to be hardly noticeable, while 2 cases experienced severe pain, vomiting, and cyanosis.

In running this small series of cases, it was endeavored to devise a line of treatment which would utilize a minimum quantity of quinine and plasmochin and give the patient the least discomfort, and yet be effective in clearing the blood-stream of malarial parasites. No drug which has been brought to my attention is as effective as quinine in controlling malarial fever; but this drug in large doses is often unpleasant to the patient, and it is not promptly effective in destroying gametes. In combining the above-mentioned drugs, I found that in the majority of cases a dose of more than 6 plasmochin-compound tablets daily was quite apt to quickly produce unpleasant symptoms. This, I believe, has been found to be true in experiments carried out by other observers. Hence I have decided that this (6 plasmochin-compound tablets daily) is the maximum dosage which can be utilized for routine work in the hospital. It is my opinion that plasmochin is a dangerous drug and, as the reaction and susceptibility of an individual cannot be predetermined by any means at present familiar to us, its use will be usually restricted to hospital cases.

Under plasmochin medication gametes usually disappear very promptly, although in one case which we had (not included in the series) the patient was discharged after 10 days' treatment, with gametes still persisting in the peripheral circulation. Under quinine and neoarsphenamine treatment we recorded one case in which the gametes persisted for 17 days; and they have been known to persist for much longer periods under the most intensive treatment.

It seems, then, that plasmochin in combination with moderate doses of quinine will be our most advantageous method of treatment. For economical reasons it is not feasible to have our patients return to the hospital for a 2nd course of treatment; and, from the results of previous experiments, I have reached the conclusion that plasmochin in one course, without the addition of suitable doses of quinine, is of little value in the treatment of any variety of malaria.

NOTE

In the above case reports, the ingredients of the tablets used were:

Plasmochin-compound Tablets: — .01 gram plasmochin and .125 gram quinine sulphate. Manufactured by I. G. Faberindustrie Aktiengesellschaft, Pharmiazeutsche Abt. Leverkusen.

Plasmochin Tablets: — .02 gram. Manufactured by I. G. Faberindustrie Aktiengesellschaft, Pharmiazeutsche Abt. Leverkusen.

Pink Tonic Pills: — 2 grs. quinine sulphate; $\frac{3}{4}$ gr. reduced iron; $\frac{1}{50}$ gr. arsenious acid; $\frac{1}{8}$ gr. ext. nux vomica. (United Fruit Company formula).

COMPARISON OF THE COMBINED PLASMOCHIN AND QUININE TREATMENT WITH THE PLAIN QUININE TREATMENT

E. J. WHITAKER, M.D.

Tela Railroad Company Hospital

Tela, Honduras

COMBINED QUININE AND PLASMOCHIN TREATMENT

Number	Average Days of Treatment	Daily Dose	Results
33 Cases	6½	Quinine, grs. xxx Plasmochin, 0.06 gm.	*4 cases, crescents 2 cases, E.A. rings 27 cases, negative

* It is only fair to call attention to the fact that the cases which showed positive findings after the combined treatment averaged only five days of treatment.

PLAIN QUININE TREATMENT

Number	Average Days of Treatment	Daily Dose	Results
29 Cases	7 $\frac{1}{3}$	Quinine, grs. XL	6 cases, crescents 5 cases, rings 18 cases, negative

DETAIL OF SEVEN CASES TREATED BY PLAIN QUININE
FOLLOWED BY COMBINED TREATMENT

Blood Findings	Plain Quinine Treatment	Blood after Plain Quinine Treatment	Quinine and Plasmochin Treatment	Blood after last Quinine and Plasmochin Treatment
No. 1. E.A. rings	40 Gr. 6 Days	Crescents	30 Gr. 7 Days 0.06 gm.	Negative
No. 2. E.A. rings	40 Gr. 5 Days	Crescents	30 Gr. 5 Days 0.06 Gm.	Negative
No. 3. E.A. rings +	60 Gr. 5 Days	Crescents	40 Gr. 4 Days 0.06 Gm.	Negative
No. 4. E.A. rings +	50 Gr. 7 Days	E.A. rings and crescents	30 Gr. 5 Days 0.06 Gm.	Negative
No. 5. E.A. rings and Crescents	40 Gr. 8 Days	Crescents	30 Gr. 5 Days 0.06 Gm.	Negative
No. 6. Crescents	30 Gr. 6 Days	E.A. rings and crescents	30 Gr. 4 Days 0.06 Gm.	Negative
No. 7. E.A. rings	30 Gr. 9 Days	Crescents	30 Gr. 6 Days 0.06 Gm.	Negative

The above tables show a comparison, in a small number of malaria cases, of the routine quinine treatment and the combined quinine and plasmochin treatment as advocated by Dr. W. E. Deeks and Dr. R. C. Connor. The results speak well for the combined treatment, and especially so as regards the disappearance of the gametocytes. These cases had all been under quinine treatment for at least a week; and some of them, particularly the E. A. cases, were very heavily infected.

Mr. J. C. McDaniel, our Laboratory Technician, made all the thick-smear Giemsa-stained examinations; and they are therefore absolutely reliable.

Toxic effects of the plasmochin appeared in 6 of the 40 cases treated, in the form of mild cyanosis. This appeared in 3 of these cases after 4 days of treatment, and in the other 3 cases after 7 days of treatment. A series of seven cases, in which the plain quinine treatment was used at first and then followed by the combined treatment, is reported above.

The whole series, although a small one, shows the advantage of the combined treatment.

COMBINED QUININE AND PLASMOCHIN TREATMENT FOR MALARIA IN HAITIAN NEGROES

WALTER MENK, M.D.

United Fruit Company Hospital

Banes, Cuba

We inaugurated our use of the new drug, plasmochin, during the present year (1927), for the treatment of hospital cases of malaria. The daily amount administered ranged from .04 gram to .06 gram. The majority of the patients were adult negroes. Our first experience demonstrated that these doses, without the addition of quinine, are not always sufficient to check the fever and control a heavy infection. Our next step was to include more quinine with the plasmochin-compound tablets, so that the daily doses of quinine would range from 20 to 30 grains. The effect of plasmochin .06 gram a day is marked, but as a rule this is not very apparent until the close of about the 4th day of treatment. Of course, even after 8 days of such treatment, an occasional case will reveal crescents in the blood-film. The disappearance of crescents is less prompt when plasmochin is used in .04 gram daily amounts with 20 to 30 grains of quinine. One case under this form of treatment and suffering from aestivo-autumnal malaria associated with bacillary dysentery, became negative for parasites on the 5th day; but at the same time there was a rise of temperature, accompanied by a slight haemoglobinuric attack of 3 days' duration. Prompt recovery occurred without any special treatment.

During the early months of 1928 I have followed some suggestions of Dr. Deeks, who wished to learn the minimum effective and safe dose of plasmochin over a period of one week's treatment. He desired to combine this drug with quinine for the treatment of the negroes in the camps. It has been the experience in Cuba that the Haitian negroes can not tolerate as large doses of plasmochin as other races. I have taken 110 cases of malaria treated in our hospital for these special observations:

31 were given plasmochin .02 gram daily, plus 20 to 30 grains of quinine; 43 were given plasmochin .03 gram daily, plus 20 to 30 grains of quinine; and 36 were taken as a control series and treated with quinine alone, 30 grains daily as given routinely in the treatment of malaria in the hospital. The results obtained are listed in Table A, page 80, of this article.

EXPLANATORY NOTES

The thick blood-film reexaminations included a search of 100 oil-immersion microscopic fields. As the purpose of the work was to learn whether parasites were in the blood-films at the time of the discharge of the patients from the hospital, these blood-films were taken on the 4th day of plasmochin treatment, and on the 5th day of the quinine series under control treatment. Another film was examined the day before discharge or the day of discharge. It usually happened that all of the cases received a half-day's treatment with quinine alone before they were placed in the 3 experimental series. Each of the plasmochin-compound tablets used in the series contained .005 gram of plasmochin and .0625 gram of quinine. All of the cases in these series were admitted to the hospital primarily for the treatment of acute malaria, and presented no important clinical evidence of other associated diseases. The individuals treated were recorded in the order of their admission to the hospital, without any effort at group selection. Several of the cases of malaria in each series were jaundiced. The icterus did not appear to be intensified by the treatment with plasmochin. The series of cases treated with plasmochin-compound tablets, 2 b.i.d., was completed first; then followed the series treated with plasmochin-compound tablets, 3 b.i.d.; and finally the series treated with quinine alone. The 2 quinine-plasmochin series included, accidentally, more clinically severe cases of malaria than the quinine series. The heavy ring-infections were most frequent in the series treated with plasmochin compound .03 gram a day. This series also showed a higher number of crescent-carriers. The quinine control-series showed the greatest number of patients with both ring and crescent forms on the day of admission.

As the harvest period progressed, enlarged spleens were more frequently noted in the negroes than at the beginning of the harvest. These negro patients get no pay while in the hospital, and they are therefore anxious to leave it as soon as their symptoms subside. Our average period of treatment is about 7 days.

The crescents generally decrease more or less in proportion to the length of time the patient is under treatment, but the decrease is greatly delayed in many cases where quinine alone is used. It is my opinion, based on this personal experience, that the combined treatment with plasmochin compound and quinine is far superior to the use of quinine alone, because the latter requires a longer period of hospital care than we can provide. I shall repeat these experiments at the end of the harvest season, in order to check the results obtained in the 3 groups.

TABLE A
TABULATED RESULTS IN THE THREE SERIES OF CASES

Character of Treatment given in the 3 series	Plasmochin-compound tablets 2 b.i.d. plus quinine grs. 20, and sometimes grs. 30, a day	Plasmochin-compound tablets 3 b.i.d. plus quinine grs. 20 a day	Quinine, alone, grs. 30 a day; oral administration, as a rule
	E.A. malaria cases 27 Quartan cases 2 Mixed infections 2 <hr/> 31	E.A. malaria cases 41 Quartan case 1 Tertian case 1 <hr/> 43	E.A. malaria 35 Tertian 1 <hr/> 36
Number of cases showing crescents in blood films on admission:			
(a) total	5	12	13
(b) cases with abundant crescents .	2	3	5
Number of cases showing crescents during course of treatment:			
(a) total	18	16	22
(b) cases in which no crescents on admission but did appear during course of treatment	13	4	9
Number of cases showing crescents at time of discharge from the hospital:			
(a) total	3	6	20
(b) Cases showing abundant crescents	0	0	3
Number of cases becoming negative on 4th to 7th plasmochin day, and 5th to 8th day in quinine control-series .	24 (22 E.A. cases)	33 (31 E.A. cases)	12 (11 E.A. cases)
Number of cases becoming blood-film negative later in course of treatment:			
(a) Under continued plasmochin- quinine treatment	2	3	2
(b) Under quinine treatment alone, or cases continued on quinine after the close of plasmochin treatment	2	1	On account of dis- charge against advice
Total cases negative for parasites at the time of discharge	28	37	14
Number of cases discharged with posi- tive blood-films up to 7th day in plasmochin series, and 8th day of quinine series	0	(2 on 7th day and 1 on 5th day) 3	8th—10 7th— 5 6th— 5 5th— 1—21
Total positives discharged	3	6	22 (2 cases with very few rings)

The quinine series shows the striking contrast in the condition of the blood-films on discharge from the hospital, and I believe it reflects the facts in regard to the efficacy of the quinine-plasmochin method. Toxic symptoms directly due to plasmochin were not observed in the series.

One case deserves special mention. This patient was admitted to the hospital in a drowsy state due to a very heavy infection with aestivo-autumnal malaria.

He was first given quinine injections, followed by 30 grains of quinine and plasmochin compound (.01 gram) b.i.d. At the close of 6 days of this combined treatment he had a series of epileptiform attacks, which were not accompanied by fever; though, at the same time, large numbers of crescents were present in the peripheral blood. The day previous to these attacks crescents were present in only moderate numbers. Treatment with plasmochin was stopped. The attacks recurred during the next few days, but were fewer in number and of less intensity. Treatment was then continued, intramuscular injections of quinine alone being used. The crescents diminished gradually, but were still present, at the time of his discharge from the hospital. This case is included in the plasmochin-quinine series.

It is my opinion that the safe dosage indicated for routine use in camp treatment of the negroes is .03 gram of the plasmochin compound, combined with 20 grains of quinine a day over a period of one week; I have given it continuously for 10 days without causing any disagreeable symptoms. The fact must be stressed that in all of these so-called plasmochin-series cases full therapeutic doses of quinine have been used. I do not think that the addition of plasmochin gives any better immediate *clinical* results, but the small amount of plasmochin given with the quinine seems to be sufficient to considerably improve our results, from the viewpoint of malaria-control. If anything is shown by the quinine series, it is the epidemiological danger connected with the insufficient duration of treatment with this drug. Quinine treatment alone as a control measure is obsolete if we can only treat the cases of malaria for one week, and then discharge a high percentage of patients carrying crescents into an environment favoring the spread of malaria. Such crescent-carriers should be treated in a screened hospital or house; yet under the old method of quinine treatment alone we would soon be retaining enough cases of this order to more than fill a large hospital. These cases respond very well, in most instances, to a short course of treatment with quinine-plasmochin doses as used in these series of cases.

EFFECTS OF QUININE ON MALARIA PARASITES

R. L. CARROLL, M.D.

Almirante Hospital, Almirante, Panama

This report is based upon the treatment of 100 cases of positive malaria admitted to Almirante Hospital. Some of the patients were admitted for other conditions, and malaria was found as a secondary complication. In all cases 3 grams of quinine sulphate were given daily for 1 week; and subsequently the dose was reduced to 2 grams daily. Ninety of the cases had aestivo-autumnal malaria; 5 had tertian; 4, quartan; and 1 was a mixed infection of aestivo-autumnal and tertian. The bloods were examined daily by the thick-film method.

The blood became negative for ring forms on an average of 3.8 days after the beginning of treatment; and for gametes, on an average of 5.6 days after their first appearance in the peripheral blood. Of the 100 cases, 11 showed gametes on admission; and, of these 6 only had also ring forms. Of the cases that had only ring forms on admission, 18 developed gametes during the quinine administration; so that, of the 100 cases, 29 showed gametes in the peripheral blood at some time during their treatment. In those cases that showed no gametes in the peripheral blood on admission, but developed them subsequently, the gametes appeared on an average of 5.7 days after the quinine administration was begun, — the longest time being 14 days.

In only 2 cases did gametes persist in the peripheral blood for long periods under quinine treatment. In one of these, plasmochin was given on the 10th day, and the blood became negative on the 16th day; and in the other case plasmochin was begun on the 22nd day, and the gametes disappeared within 4 days.

INTRAMUSCULAR INJECTIONS OF QUININE

THEODORE DE LA TORRE, M.D.

Banes Hospital, Banes, Cuba

In December, 1926, I was appointed District Medical Officer for the Banes Division of the United Fruit Company, and assigned to the district of Deleyte, formerly Tacajo. Thick blood-film surveys of this district had revealed that almost the entire population was suffering with malaria, and blackwater fever was very common. The area is lowland sugar-cane fields (lowest in the Banes Division), and is surrounded by numerous small, sluggish streams that partly dry up during the dry season. There are about 950 inhabitants in the Deleyte village proper, and the nearby villages have an estimated population of about 600. During the crop there are over 2,000 Haitians working in this district, 25 per cent of whom arrive in Cuba already infected with malaria.

In an effort to control the disease, free distribution of quinine sulphate in the form of tablets of 5 grains each has been the practice of the Company for years, but with apparently no success. A close investigation of this free distribution of quinine disclosed a fixed aversion of the people to taking this drug, many claiming they could not hold quinine in the stomach; a few feared that it was the quinine that caused blackwater fever. Others gave no reason except their dislike for quinine. The fact was, that the tablets were accepted by the people but thrown away by most of them as soon as they were out of sight of the distributor. In view of these conditions, something had to be done to combat the increasing rate of malaria and blackwater fever, so I decided to administer the quinine by intramuscular injections.

An immediate campaign was necessary to allay the fear of the people concerning this method of treatment, as it was the opinion of many that quinine injections would cause abscesses which oftentimes proved serious. Influential residents were induced to try the method, and in this way I slowly gained the confidence of all. The results obtained have been very gratifying. In one year, the record of cases of malaria from Deleyte District has dropped from the highest in the whole division of Banes to the lowest of any district; blackwater fever has practically disappeared. General health conditions have improved, and of the 9,000 injections given during the year 1927, there have been only 4 quinine-hypo abscesses; two in small children, and two in adult women.

Judged by the results obtained so far by intramuscular injections of quinine, the method is in my opinion the one that best meets all requirements for the treatment of acute and chronic malaria where the people cannot be depended upon to follow instructions in taking quinine. This is especially so in outlying sick-camp and dispensary practice. I believe that this method of treatment can be more generally used by nurses and field dispensers, if they will only observe careful technique.

Complete asepsis is necessary. Syringe and needle are thoroughly sterilized for each individual injection, by boiling. The skin over the region to be injected (the gluteal) is disinfected with alcohol. It is important that the injection be made deeply and slowly into the gluteal muscles, alternating right and left sides for each injection, after which the area should be thoroughly massaged. The discomfort during and after the injection is slight, and rarely complained of, especially if the solution is lukewarm. To obtain this temperature I make use of the syringe immediately after taking it out of the boiling water. Inflammatory reaction is rare, and when it occurs it rapidly subsides with light massage and warm applications. For bed patients, a hot-water bag is applied over the part. For those not confined to bed, light exercise is recommended; horseback riding is beneficial, and seems to give the massage necessary to promote absorption.

Ampoules containing 1 to $1\frac{1}{4}$ cc. of the sterile solution of dihydrochloride of quinine in doses of 0.25 to 1 gm. each, are the most satisfactory preparation for intramuscular injection. These ampoules are obtainable in any drug store on the island of Cuba. I have found those prepared by Carlos Erba of Milan especially satisfactory.

In severe attacks of malaria adults are given 1 to 2 injections of 1 gm. each per day, rarely more. In children the dose is graduated according to the age. With those cases who have suffered a previous attack of blackwater fever, I invariably begin with a small dose, watch its effect on the urine, and increase the dose daily, or stop quinine medication altogether, if symptoms of blackwater develop. It is generally accepted that quinine may precipitate a latent attack of blackwater, although I have found in practice that cases who have previously had blackwater fever tolerate quinine well. In the average case of malaria I give 1 gm. daily intramuscularly for a period of 4 to 6 days, then only twice a week, for at

least 3 weeks, and follow this treatment with Pink Tonic Pills (a modified Aiken's Tonic formula).

CONCLUSIONS

(1) That this is an effective and practical method of quinine administration, and the only dependable one when treating people with acute and chronic malaria who object to taking quinine, and who cannot be depended upon to follow instructions regarding the oral administration of the drug.

(2) In outlying sick camps and dispensaries the method can be used to advantage by nurses and field dispensers without danger of necrosis or abscess formation, if they will only observe the usual aseptic precautions.

(3) The absorption of the drug is slow but certain, and its effect is assured. The cost of treatment is small in comparison to that of hospitalization. This method of administration has undoubtedly saved many lives, and the 1927 records of Deleyte Dispensary when compared with those of past years, show that the hospital admission and the sick-day rate among laborers in this district have been greatly reduced.

EDITOR'S COMMENTS

Based on the clinical and laboratory data reported in this section, and also on the work of a great many other observers, certain conclusions seem justifiable in regard to the results to be expected by the exhibition of quinine and plasmochin individually and in combination, in the treatment of malaria:

(1) Quinine is a specific against the schizonts of all types of malaria, and these are responsible for the clinical symptoms. In acute cases it is the drug of election; and in order to get prompt results, large doses must be given (2 to 3 grams daily in divided doses). In pernicious and persistent cases, part or all of this must be given intramuscularly or intravenously, until the acute symptoms subside. Then oral administration suffices.

(2) In acute cases the exhibition of quinine for short periods favors for some unknown reason the appearance of gametocytes in the peripheral blood. This observation was made by Dr. H. C. Clark in his malaria surveys in 1926, and a preliminary report was published in the *American Journal of Tropical Medicine*, Vol. VII, January, 1927. The observation was confirmed by Dr. W. Cordes, and referred to in the *Fifteenth Annual Report* (1926) of the Medical Department of the United Fruit Company, page 66. The reader is also referred to Dr. O. T. Brosius' report in his Series I, page 42, in this section. In explanation of this phenomenon, two hypotheses are submitted:

(a) That the exhibition of quinine determines the gametocytes from the deep viscera to the peripheral blood, or

(b) It creates an environment which favors the development of increased numbers of gametocytes.

This may be considered as Nature's method of self-preservation of the species, and is comparable to what takes place in all forms of free-living unicellular life. When the nutritional conditions are favorable, multiplication takes place asexually. When the environment becomes unfavorable, the organisms, after conjugation, assume the cystic or resting stages until conditions are again favorable for their asexual multiplication. When malarial gametocytes in the peripheral blood are increased in numbers, mosquitoes are more readily infectible.

(3) Gametocytes developed under quinine administration are viable, as shown by Darling, Ross, Barber, and Wenyon. The observations in this connection were referred to in the *Fifteenth Annual Report* (1926) of the Medical Department, page 37.

(4) Plasmochin is mainly effective against gametocytes, and it also has a marked action in clearing the schizonts of the tertian and quartan types of malaria from the peripheral blood. On the schizonts of the aestivo-autumnal types, its action is negligible. It apparently does not prevent the development of blackwater fever, as can be noted from Doctor Brosius' report, Series A and B, — page 40. Moreover, it is not as effective in preventing relapses when administered alone as it is in combination with quinine.

(5) It appears from the few observations made by Dr. Barber and Mr. Komp (see page 54), to have a toxic action on the crescents, as, after a few doses, mosquitoes feeding on these individuals do not become infected. This observation is exceedingly important, and if it is confirmed, plasmochin must be considered of paramount importance in malaria control.

(6) If given in too large a dosage, or over a too prolonged period of time, plasmochin may cause toxic symptoms. In a small percentage of cases there appears to be an idiosyncrasy for the drug, and this is the case also with some people when taking quinine. The daily dosage should not exceed .06 gram, and this should not be continued over a period exceeding 6 days, unless the patient is under the closest daily observation. Apparently doses in excess of this are not more effective against the parasites, as can be noted from Dr. Brosius' report, Series B (page 40).

(7) The toxic symptoms take the form of headaches, giddiness, gastric distress, cyanosis, etc., and the drug may cause death. Clinical findings at the onset of toxic symptoms are leukocytosis and erythrocyte degenerations (see Dr. Cordes' report, page 62).

(8) The administration of quinine in combination with plasmochin apparently prevents the development of toxic symptoms, and because of this and the therapeutic action of the two drugs on the different phases of the parasites, they should always be given in combination in order to get the best clinical results.

(9) Our experience indicates that for an adult the amount of quinine to be given daily in combination with plasmochin, depends on the clinical symptoms. In chronic cases without acute symptoms, 1 gram daily will suffice. In acute cases, from 2 to 3 grams daily are necessary in order to obtain optimum results.

(10) In ambulatory cases not under daily supervision, the daily dosage of plasmochin should not exceed .04 gram, in combination with 1 to 2 grams of quinine, for a period not to exceed 6 days; or .06 gram plasmochin, with the same dosage of quinine, over a period not to exceed 4 days. Whenever possible, all cases so treated should return for a reexamination within from 3 to 4 days after the course is completed; and if parasites are still present, a 2nd course of treatment is indicated.

(11) All ambulatory cases should be warned that if they experience headaches, dizziness, or gastric distress, or if blueness develops in the face or lips, the drug should be immediately suspended, and that they should report to the physician for further instructions.

(12) If, on a thick-film survey, the camp population should be heavily infected, 60 per cent or over, blanket treatment of the whole population is recommended, and the course of treatment should be administered in accordance with the dosage referred to above. Within from 3 to 4 days after the last treatment is given, the camp should be resurveyed; and if any cases are still found positive, another similar course of treatment should be instituted. It has been demonstrated that the heavily-infected carriers (frequently without acute symptoms) most readily infect mosquitoes, and that one heavily-infected mosquito may transmit malaria for 3 months at least. The importance of repeated surveys therefore, to discover and treat the carriers, cannot be too highly stressed, and it would be highly advantageous if this could be done during the dry season. This will prevent the high incidence of mosquito infection later on during the rainy season when conditions are more favorable for their multiplication.

SPLEEN AND PARASITE RATES AS MEASURES OF MALARIA IN THE CARIBBEAN AREA*

H. C. CLARK, M.D.

United Fruit Company Medical Department

New York, N. Y.

This report is based on an extensive autopsy service in the American tropics; and upon the added experience obtained more recently while conducting surveys and the treatment of large labor forces and their families on rural plantations

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scattered among certain island and mainland countries of the Caribbean area. A large part of the labor forces in those places consists of West-Indian negroes. It was very desirable to detect, as nearly as possible, all malaria-infected individuals among those examined during the periodic surveys, in order that they might be treated; and to use the simplest and most rapid method available in diagnosis, in order that it might be applied by a limited personnel. The system of surveying a camp for enlarged spleens made a strong appeal as the most feasible method to expedite the work, since it has been generally taught that enlargement of the spleen is a constant, significant symptom in both acute and chronic malaria.

The primary object of any business organization in the Tropics, forced to contend with the malaria problem, is to save labor days; and this results, to some extent, in more pressure being exerted in caring for the adult males than for the women and children in the remote plantations. It has been generally known, of course, that the spleen rate in children is of more significance than in adults. Nevertheless, it would seem that any adult showing an active malarial infection (demonstrable parasites in the peripheral blood) would also present a definite degree of splenic enlargement. The method does reveal a certain number of people with the disease who have a spleen that is definitely palpable. In fact, it is serviceable as a rapid preliminary measure to determine whether malaria is present in a given community; but, as a quantitative method for selecting adult males in need of treatment, it does not meet business requirements—at least, not in the Caribbean area. Its success is limited, even when applied to children. An opportunity to collect some data on the respective values of the spleen rate and the parasite rate in a large number of Haitian negroes, recently presented itself. The results of these examinations, together with recorded facts accumulated from past autopsy experience in the Caribbean region, lead one to conclude that the spleen rate, in these negroes, has less significance than in other races of the same region. The sizes of the spleens in several of the negroes in the West-Indian group coincide with those recorded in Oudendal's¹ reports on the Javanese and Chinese laborers in the eastern Tropics.

The recent application of the spleen and parasite rates to which your attention is directed, was conducted in the northern peninsula of Haiti during the weeks which followed the apex in rainfall for that region. These records cover the examination of 11,000 adult Haitian negroes and 1,102 Haitian negro children. The method used in palpating the spleen was neither the standing nor the recumbent position, although it combines some of the features of both methods. For the method we elected to use, I am indebted to Lieut.-Commander P. W. Wilson (MC), U. S. N., Chief of Medicine in the Haitian General Hospital at Port au Prince, Haiti.

The nude subject under examination was seated astride the end of a narrow bench, with his elbows resting on his knees and his chin resting on the palms of his hands. The examiner took his seat astride the same bench and immediately

behind the man under examination. The right hand of the examiner could then rest firmly on the back of the man being examined, while the palpating hand could introduce the tips of the fingers beneath the costal margin. The relaxation of the abdomen, during the time necessary for 2 or 3 deep inspirations, afforded a good opportunity to feel an enlarged spleen. In fact, I think that some spleens which did not represent significant degrees of enlargement may have been recorded.

The parasite rate was determined by using 4 or 5 small drops of blood from the lobe of the ear. This blood was spread into a circular spot about $\frac{3}{8}$ " in diameter. The slides were then assembled and stained according to the modification of the thick-film method recommended by Barber and Komp.² The examination of a given slide was terminated after 50 microscopic fields had been examined. A solitary blood-film was examined from each person. An infection was recorded as heavy if 5 or more parasites were found in one field, while a medium infection was one that revealed 5 or more parasites in several fields, and a light infection was indicated by finding a few parasites in the entire search.

The same methods used on the adults were applied to 1,102 children ranging from 2 to 12 years of age. These negro children were dwelling and examined in the same villages and rural communities where the adult negroes lived. The only variant in this examination was that the children were not undressed, since it was an easy matter to slip the palpating hand under their loosened clothing (usually a one-piece garment) and effectively palpate the splenic area. These spleen rates were determined by a number of doctors who had had considerable clinical experience in physical examinations in their hospital and dispensary services. The parasite rates were determined almost entirely by 2 doctors and 1 technician familiar with the Barber and Komp method of thick-film examination. The results of these investigations now follow: the spleen rate of the 11,000 adult Haitian negroes (not under treatment for malaria) was 3.05 per cent, while the parasite rate was 23.5 per cent. The spleen rate of 1,102 Haitian negro children was 22.77 per cent while the parasite rate was 41.9 per cent. The relation of these two rates varied, to some extent, in the children of different communities.

TABLE I
DEGREES OF INFECTION FOUND BY PARASITE RATES

	Adult Males	Children
Heavy infections	653 (25.2%)	55 (11.9%)
Medium infections	878 (34.0%)	205 (44.4%)
Light infections	1,054 (40.8%)	202 (43.7%)
	<u>2,585</u>	<u>462</u>

There was no constant relationship between the heavy infections and the spleens that were palpable.

TABLE II
SPECIES OF MALARIAL PARASITES FOUND IN SURVEY

	Adult Males	Children
Aestivo-autumnal	2,231 (86.30%)	361 (78.14%)
Quartan	336 (13.00%)	91 (19.70%)
Aestivo-autumnal and quartan	9 (0.34%)	8 (1.73%)
Tertian and quartan	1 (0.04%)	0 (0.0 %)
Tertian	8 (0.31%)	2 (0.43%)

Surveys have now been applied on two successive years to the negroes residing in this territory, and the quartan rate each year was very high. It occupies a position more or less similar to that held by the tertian infections along the mainland of the Caribbean Sea. The bulk of the infections were aestivo-autumnal in character. The palpable spleens showed no very marked tendency to be associated more frequently with quartan infections than with the aestivo-autumnal cases.

TABLE III
SIZES OF THE ENLARGED SPLEENS FOUND IN THE SURVEYS

	Adult Males	Children
Spleens that were just palpable	264 (78.8%)	131 (52.2%)
Spleens 1 finger below costal margin	47	68
Spleens 2 fingers below costal margin	18 (21.2%)	40 (47.8%)
Spleens 3 fingers below costal margin	5	11
Spleens 4 fingers below costal margin	1	1
	335	251

This table shows that only 47.8 per cent of the palpable spleens in children were below the costal margin, while but 21.2 per cent of the palpable spleens in adult men showed this degree of enlargement.

TABLE IV
THE PARASITE RATE IN THE INDIVIDUALS WITH ENLARGED SPLEENS

	Adult Males	Children
Blood positive for malarial parasites	110 (32.8%)	175 (69.7%)
Blood negative for malarial parasites	225 (67.2%)	76 (30.3%)

It is, therefore, found that 2,475 out of 2,585 negro men who were positive for malarial parasites did not have palpable spleens, and that 287 children out of 462 that were positive for malarial parasites did not have palpable spleens.

TABLE V
SPECIES OF PARASITES FOUND IN INDIVIDUALS WITH ENLARGED SPLEENS

	Adult Males	Children
Aestivo-autumnal	92	121
Quartan	18	49
Aestivo-autumnal and quartan	0	5
	110	175

None of the 11 tertian infections recorded in Table II was found in individuals with palpable spleens. It has been the experience that marked acute enlargement of the spleen has been associated with the benign malarial fevers, tertian and quartan. It may be stated, for those who are interested, that 4 adults and 1 child showing enlarged spleens also revealed micro-filaria in the blood films.

Autopsy service and field medical experience in the Tropics have, for many years, impressed me with the apparently unusual circumstance that a significant degree of acute or chronic enlargement of the spleen is far more frequently found in the Latin-American labor class than in the negro labor class that live under the same conditions. The anatomical records of the early construction days of the Panama Canal contain numerous entries of "Colombian spleen," a local name applied in those days to any spleen showing extreme chronic enlargement in a Latin-American individual.

So much has been written on the spleen rate and its method of application, that I fear some may now credit it with a simplicity and significance that are not fully deserved. I am skeptical as to whether the average individual can palpate a spleen that is not at or below the costal margin, with any greater degree of success than he can stain and examine a thick blood-film for parasites. Furthermore, Oudendal's¹ work shows that a number of congenital variations, and physiological and pathological conditions, can interfere with a correct determination of a spleen rate when applied to the different races. It is difficult to precisely ascertain the normal size of the spleen in different races or to determine what actual size is definitely and safely palpable. Clinicians in well-organized hospital services do not always agree on whether or not slightly enlarged spleens are palpable; and naturally this difficulty in diagnosis is greatly increased when it becomes necessary rapidly to make a large series of spleen palpations in the field.

Piersol³ records the weight of the spleen in man as 195 grams, while Cunningham⁴ gives it as 160 grams; and Cattell⁵ states, in reporting his experience at autopsy, that the organ varies in size and weight even in healthy young adults, and may weigh anywhere from 80 grams to 200 grams. Ordinarily, he claims, its weight in adults is between 100 grams and 300 grams, with an average of 170 grams. Oudendal's observations in the eastern Tropics show that any spleen weighing over 100 grams is larger than a "normal Indian spleen"; and his records included the Javanese and Chinese laborers of that area.

In order to present further data on the spleen of the adult negro in the Caribbean area, in addition to those obtained during the surveys in Haiti, I have collected a few groups of other West-Indian negroes and Latin-Americans that I have been able to study at autopsy. These are groups of fatal cases of aestivo-autumnal malaria (or mixed cases of malaria), blackwater fever, typhoid fever, lobar pneumonia, etc., which, at autopsy, appeared to be comparatively free from associated diseases. Intestinal parasites, focal tuberculosis, latent malaria, etc., were, however, frequently associated; and an occasional case showed a positive Wassermann test. These series of cases are composed chiefly of adult men

between the ages of 20 and 50 years; but a few women, whose body weight and height seemed to compare favorably with those of men, were also included. My "yard stick" group, which is to be used as a normal approximation, is a collection of people who were apparently in good health at the time they lost their lives as the result of one of the various forms of external violence. No case of this nature was included if the spleen had sustained any injury. The people who comprise these groups were all living in unscreened quarters in the coastal plain-area of the Caribbean Sea. Some of them dwelt in localities which had had the advantage of Canal Zone anti-mosquito campaigns, but their duties kept them in comparatively unsanitated regions. These were laborers employed during the very early years in the construction period of the Panama Canal. No case of external violence was included in the series if the individual had lived a sufficient length of time after the injury to develop an inflammatory disease. The spleen weights recorded were taken soon after the removal of the spleen from the body, and after all extraneous tissues had been cut away.

TABLE VI

TOTAL AUTOPSY SERIES OF CASES BY AGE GROUPS

Age (Years)	Panama Canal Zone West-Indian Negroes	Honduras Cases West-Indian Negroes	Honduras Cases Latin-Americans	Totals
15 to 20. . . .	30	0	28	58
21 to 30. . . .	96	1	84	181
31 to 40. . . .	41	4	28	73
41 to 50. . . .	17	0	11	28
51 to 60. . . .	3	1	5	9
61 to 70. . . .	1	0	0	1
Over 70	0	1	0	1
	188	7	156	351

Race Analysis:

West Indian Negroes in the Panama Canal Zone: Barbados, 68; Jamaica, 68; other British West Indies, 39; the French West Indies, 13.

West-Indian Negroes in Honduras: Jamaica, 6; Trinidad, 1.

Latin-Americans in Honduras: Honduras, 101; Salvador, 42; Guatemala, 3; Spain, 3; Nicaragua, 4; Costa Rica, 2; Mexico, 1.

Duration of Stay on Mainland. — Of the Panama Canal Zone cases, 56 had been in that area less than 1 year. All other individuals had spent from one to a great many years on the coastal plain of the mainland facing the Caribbean Sea.

TABLE VII

WEIGHTS OF THE SPLEENS IN THE PANAMA CANAL ZONE NEGRO-AUTOPSY SERIES

Cause of Death	Number of Cases	Range in Spleen Weights (Grams)	Average Spleen Weight (Grams)
Malaria	66	80 to 500	280
Blackwater fever	7	105 to 695	375
Typhoid fever	34	85 to 830	359
Pneumonia, lobar	46	85 to 1015	327
External Violence	35	80 to 350	149

TABLE VIII

SPLEENS RECORDED AS PALPABLE AND NON-PALPABLE IN THE P.C.Z. NEGRO SERIES

Malaria Series Weight (Grams)	Number of Cases	Palpable Spleens	Non-Palpable Spleens	Positive for Pigment or Parasites
100 or less.	2	1	1	2
101 to 200.	13	10	3	13
201 to 300.	26	16	10	26
301 to 400.	16	14	2	16
401 to 500.	9	9	0	9
	66	50	16 (24.2%)	66

Blackwater Fever Weight (Grams)	Number of Cases	Palpable Spleens	Non-palpable Spleens	Positive for Pigment or Malarial Parasites
100 or less.	0	0	0	0
101 to 200.	1	0	1	0
201 to 300.	3	3	0	2
301 to 400.	0	0	0	0
401 to 500.	1	1	0	0
501 to 600.	1	1	0	1
601 to 700.	1	1	0	1
	7	6	1 (14.3%)	4

Typhoid Fever Weight (Grams)	Number of Cases	Palpable Spleens	Non-palpable Spleens	Positive for Pigment or Malarial Parasites
100 or less.	2	0	2	0
101 to 200.	7	3	4	1
201 to 300.	6	6	0	1
301 to 400.	8	8	0	2
401 to 500.	6	6	0	2
501 to 600.	0	0	0	0
601 to 700.	1	1	0	0
701 to 800.	3	3	0	0
801 to 900.	1	1	0	1
	34	28	6 (17.6%)	7

Pneumonia, Lobar Weight (Grams)	Number of Cases	Palpable Spleens	Non-palpable Spleens	Positive for Pigment or Malarial Parasites
100 or less.	1	0	1	0
101 to 200.	11	2	9	1
201 to 300.	14	4	10	4
301 to 400.	5	3	2	1
401 to 500.	6	3	3	4
501 to 600.	7	6	1	0
601 to 700.	1	1	0	0
701 to 800.	0	0	0	0
801 to 900.	0	0	0	0
901 to 1,000.	0	0	0	0
1,001 to 1,100.	1	1	0	0
	46	20	26 (56.5%)	10

External Violence Weight (Grams)	Number of Cases	Palpable Spleens	Non-palpable Spleens	Positive for Pigment or Malarial Parasites
100 or less.	9	0	9	2
101 to 200.	21	1	20	8
201 to 300.	4	3	1	2
301 to 400.	1	1	0	1
	<hr/> 35	<hr/> 5	<hr/> 30	<hr/> 13

TABLE IX

SPLEENS CONSOLIDATED BY WEIGHT GROUPS—PALPABLE AND NON-PALPABLE—
P. C. Z. NEGROES

Weight Groups (Grams)	Number of Cases	Palpable Spleens	Non-palpable Spleens	% of the Non- palpable Spleens
100 or less	14	1	13	92.9
101 to 200	53	16	37	69.8
201 to 300	53	32	21	39.6
301 to 400	30	26	4	13.3
401 to 500	22	19	3	13.6
501 to 600	8	7	1	12.5
601 to 700	3	3	0	0.0
701 to 800	3	3	0	0.0
801 to 900	1	1	0	0.0
901 to 1,000	0	0	0	0.0
1,001 to 1,100	1	1	0	0.0
	<hr/> 188	<hr/> 109	<hr/> 79	<hr/> 42.0

TABLE X

PARASITES OR PHAGOCYTED CLUMPS OF PIGMENT IN THE SPLEEN FILMS AT
AUTOPSY—PANAMA CANAL ZONE NEGRO SERIES

(The 66 fatal cases of malaria are excluded from this table)

Weight Groups (Grams)	Spleens Examined	Spleens Found Positive	% of Spleens Found Positive
100 or less	12	2	16.7
101 to 200	40	10	25.0
201 to 300	27	9	33.3
301 to 400	14	4	28.6
401 to 500	13	6	46.2
501 to 600	8	1	12.5
601 to 700	3	1	33.3
701 to 800	3	0	} 20.0
801 to 900	1	1	
901 to 1,000	0	0	
1,000 to 1,100	1	0	
	<hr/> 122	<hr/> 34	<hr/> 27.8

TABLE XI

AVERAGE OF SPLEEN WEIGHTS BY NATIVITY IN DISEASES—P. C. Z. NEGROES

Nativity	Number of Negroes	Malaria*	Blackwater Fever*	Typhoid Fever*	Pneumonia	External Violence
Barbados	68	270	420	315	190	131
Jamaica	68	308	435	341	317	139
Other B. W. I. . .	39	278	225	233	434	153
French W. I. . . .	13	188	353	622	365	218
	188	280	375	359	327	149

This Table XI was prepared in order to study the Barbadians as a separate group, since malarial fever was not an endemic disease in Barbados during the construction period on the Panama Canal Zone.

TABLE XII

SPLEENS OF NEGROES EXAMINED AT AUTOPSY IN HONDURAS

Nativity	Age (Years)	Cause of Death	Weight of Spleen (Grams)
Jamaica	39	Chronic nephritis	240
Jamaica	29	Pneumonia, lobar	165
Jamaica	30	Cirrhosis of liver	160
Jamaica	74	Chronic nephritis	150
Jamaica	60	Cancer of the stomach	130
Jamaica	31	Aortic aneurysm	120
Trinidad	32	Aortic aneurysm	140

Two of the negroes in Table XII (28.57 per cent) were positive for malarial pigment or parasites in the films made from the spleen pulp.

TABLE XIII

WEIGHTS OF THE SPLEENS IN HONDURAS-LATIN AMERICAN SERIES OF AUTOPSIES

Cause of Deaths	Number of Cases	Range in Spleen Weights (Grams)	Average Spleen Weights (Grams)
Malaria	13	245 to 1,560	612
Blackwater fever	5	395 to 1,700	1,009
Typhoid fever	7	360 to 835	561
Pneumonia, lobar	68	220 to 1,475	633
External violence	8	180 to 740	456
Other diseases	55	185 to 1,420	542
	156	180 to 1,700	599

Excluding the cases of fatal malaria (12 aestivo-autumnal cases and 1 case showing aestivo-autumnal and tertian mixed infection), there were 28 cases of non-malarial deaths which showed parasites: i.e., aestivo-autumnal, 24; aestivo-

* The figures in this column represent weight in grams.

autumnal and tertian, 1; and tertian, 3. In addition to these cases (28), there were 52 which revealed malarial pigment, phagocyted clumps, in the spleen films. Thus, exclusive of the fatal cases of malaria, 55.9 per cent of the Latin-Americans studied at autopsy revealed evidence of recent malarial activity; and, indeed, parasites in small numbers may have been present at the time.

Unfortunately, I can not supply for the Latin-American series of cases the comparative data, as listed for the negro in Table VIII, because the clinical records are not available for this series.

TABLE XIV

MALARIAL PARASITES OR PHAGOCYTED PIGMENT IN CLUMPS FOUND IN SPLEEN FILMS, LATIN-AMERICAN SERIES OF AUTOPSIES IN HONDURAS

(The 13 Fatal Cases of Malaria are Excluded from This Table)

Weight Groups (Grams)	Spleens Examined	Spleens Positive	% of Spleens Positive
100 or less	0	0	0.0
101 to 200	2	2	100.0
201 to 300	20	10	50.0
301 to 400	20	16	80.0
401 to 500	24	14	58.3
501 to 600	20	13	65.0
601 to 700	14	6	42.9
701 to 800	11	3	27.3
801 to 900	11	4	36.4
901 to 1,000	8	4	50.0
1,001 to 1,100	1	0	61.5
1,101 to 1,200	2	1	
1,201 to 1,300	2	2	
1,301 to 1,400	2	1	
1,401 to 1,500	4	2	
1,501 to 1,600	0	0	
1,601 to 1,700	1	1	
1,701 to 1,800	1	1	
	143	80	55.9

It is not possible for me to give the records on autopsies in Table XV, in regard to their body height and body weight, but I can offer a short series of 34 cases in which these data were based on the nude body just before the autopsy was performed. Thirteen of the negro cases to be given are taken from the original 35 cases of external violence, but the rest of the series represent individuals entirely outside the 3 series so far discussed.

TABLE XV
CONSOLIDATED SPLEEN WEIGHTS IN THE 3 AUTOPSY SERIES

Weight Groups (Grams)	P. C. Z. W. I. Negroes	Honduras W. I. Negroes	Honduras Latin-Americans
100 or less	14	0	0
101 to 200	53	6	2
201 to 300	53	1	22
301 to 400	30	0	23
401 to 500	22	0	27
501 to 600	8	0	21
601 to 700	3	0	14
701 to 800	3	0	12
801 to 900	1	0	12
901 to 1,000	0	0	8
1,001 to 1,100	1	0	1
1,101 to 1,200	0	0	2
1,201 to 1,300	0	0	3
1,301 to 1,400	0	0	2
1,401 to 1,500	0	0	4
1,501 to 1,600	0	0	1
1,601 to 1,700	0	0	1
1,701 to 1,800	0	0	1
	188	7*	156

TABLE XVI

RELATION OF SPLEEN WEIGHT TO BODY HEIGHT AND BODY WEIGHT IN 4 RACES
34 CASES OF EXTERNAL VIOLENCE

PANAMAN (LATIN-AMERICAN):

Age	Body Height	Body Weight (Pounds)	Spleen Weight (Grams)	Spleen Examined for Parasites or Pigment
28	5' 8 $\frac{1}{4}$ "	165	185	Pigment
27	5' 8 $\frac{1}{2}$ "	127	215	Negative
25	5' 5"	116	205	Pigment
35	5' 5"	102	500	Negative
27	5' 5"	128	450	Pigment
30	5' 4"	106 $\frac{1}{2}$	200	Pigment
70	4' 8"	101	520	Negative

NEGROES, WEST INDIAN, C. Z.:

39	5' 10"	123	195	Negative
35	5' 8"	130 $\frac{1}{2}$	180	Pigment
40	5' 8"	159	300	Negative
30	5' 7"	134	205	Negative
20	5' 7"	148 $\frac{1}{2}$	175	Pigment and par.
38	5' 5"	143 $\frac{1}{2}$	130	Pigment
20	5' 5"	134	90	Pigment and par.
25	5' 5"	127 $\frac{1}{2}$	155	Negative
40	5' 4 $\frac{1}{2}$ "	149 $\frac{1}{2}$	125	Negative
30	5' 4"	128 $\frac{1}{2}$	85	Negative
20	5' 4"	98	95	Negative
45	5' 3"	128	80	Negative
20	4' 11"	126 $\frac{1}{2}$	155	Negative

* These cases belong in the "other diseases" group.

TABLE XVI. — Continued

UNITED STATES, C. Z., WHITES:

Age	Body Height	Body Weight (Pounds)	Spleen Weight (Grams)	Spleen Examined for Parasites or Pigment
25	6'	152	175	Negative
30	5' 11½"	172	170	Negative
33	5' 10½"	141	100	Parasites, E.A.
25	5' 10"	139	150	Negative
25	5' 8½"	145	115	Negative
30	5' 8¼"	152	100	Negative
25	5' 8"	147	155	Negative
45	5' 6"	126	115	Negative
40	5' 5"	113	95	Negative
40	5' 4"	150	100	Negative
25	5' 3"	110	60	Negative
40	5' 2½"	121	125	Negative

CHINESE, C. Z.:

30	5' 4"	124	65	Negative
35	5' 4"	125	95	Negative

There seems to be no sharply defined relationship between the size of the spleen and the height or weight of the body. *Panamans*, (7) showed a spleen-weight average of 325 grams and a body-weight average of 121 pounds. *West-Indian negroes* (13) gave an average spleen weight of 151 grams and a body-weight average of 133 pounds. *United States (white) Citizens* (12) gave an average spleen weight of 122 grams and a body-weight average of 139 pounds. *Chinese* (2) gave an average spleen weight of 80 grams and a body-weight average of 124½ pounds.

Malaria was never present in Barbados until very recently, so that the young Barbadian laborers who visited the Canal Zone in the very beginning of the American construction period were non-immunes to a certain extent. These men furnished some very malignant cases of malarial fever, and a number of them died. The spleens in these men, at autopsy, showed a very tense, delicate, chocolate or slate-colored capsule; and the pulp was so soft that considerable care was necessary, in lifting the organ out of the abdomen, to avoid rupture of the capsule. This pulp was in a semi-liquid state, and varied in color from a rich chocolate to a dark slate or maltese. In spite of these acute changes, the degree of enlargement was not in proportion to the other acute changes. Enlargement was seldom a truly significant feature. Noland and Watson⁶ reported 3 cases of spontaneous rupture of the malarial spleen: 1 occurred in a Barbadian negro; a 2nd, in an old world Spaniard; while the 3rd was in a Jamacian negro. The first 2 cases carry no weight record of the spleen, but the spleen was removed at operation in the 3rd case and the weight of it was recorded as 140 grams.

Attention should be directed to the fact that from 70 to 80 per cent of the malaria found in our field surveys of the past 2 years in various parts of the Caribbean area, is aestivo-autumnal in character; and this form of the disease is not so prone to show the splenic enlargement commonly found associated with tertian and quartan fever cases.

The large, hard, red spleen, "ague cake," that develops in certain individuals who have suffered a number of acute attacks of malaria, or who carry the disease as a chronic infection over long periods of time, is exceedingly rare in the West-Indian negroes that I have examined at autopsy or in the field surveys for malaria. It is comparatively common in the Latin-Americans, of the same age, who have lived under the same environment. Marchiafava and Bignami⁷ state that the size of the splenic tumor depends chiefly upon the duration of the infection, but seems also to be influenced by other factors: such as the individual malarial district, the age of the person, and possibly certain more individual phenomena which are as yet unknown. Baetz⁸ had a long clinical experience in the negro medical wards of Ancon Hospital, in the early years of its American administration, and he states that the hypertrophied spleens were not noticed in the negro but that they were commonly found in the Latin-American and the full-blooded Indians. Darling⁹ explained these large, chronic spleens—"Colombian spleen" or "ague cakes"—as follows:

It is a spleen which apparently has gotten into the habit of making and caring for white and red blood cells in response to a stimulus which is usually malarial in the beginning, but in which malarial parasites have disappeared or been reduced to numbers too inconsiderable to account by themselves for the splenic tumor.

All this is well borne out in the case of the Latin-American and certain white people of other origin, but it certainly does not explain the absence of such spleens in the Jamaican, Barbadian, and Haitian negroes living in the same environment. I have seen too small a number of other West Indians to include them in this statement. These large chronic spleens, at autopsy, in my experience, seldom offer gross evidence of pigmentation; and even the microscopic films made from the crushed pulp in many cases show no parasites or pigment. Those that do reveal this evidence usually show a scant number of parasites and very little pigment after a careful, extended search. These spleens must have an unusual aptitude for rapidly phagocytizing parasites and eliminating pigment. It is practically certain that the individuals possessing them, if they continue to live in their old environment, are frequently reinfected.

SUMMARY

1. The *parasite rate*, employing the thick blood-film method, for 11,000 adult Haitian negroes was 23.5 per cent, while the same test on 1,102 of their children showed a rate of 41.9 per cent.

2. The *spleen rate* for these same adults was 3.05 per cent; and for the same children, 22.78 per cent.

3. Of the 2,585 adult negroes whose blood-films were positive for the parasites of malaria, only 110 had palpable spleens. Therefore, 2,475 men with malaria would have been overlooked, had the spleen index alone been employed. Of the 462 children whose blood-films were positive for malaria, 175 had palpable spleens. Therefore, 287 children with malaria would not have been considered infected if we had used only the spleen index.

4. Of the 335 adult negroes who had palpable spleens, 225 did not have malarial parasites in their blood-films. Of the 251 negro children who had palpable spleens, 76 failed to reveal parasites in their blood-films. Of the palpable spleens found in the adult negroes, 264, or 78.7 per cent were barely palpable; while 131, or 52.2 per cent of the palpable spleens in the children were of the same type. It is possible that all the palpable spleens recorded, even though not associated with parasites in the blood films, represented latent or recent malaria. Nevertheless, the error in the spleen rate was so much greater than in the parasite rate that it has great significance for those of us who wish to treat the active cases of malaria in an adult male labor force, or even in the general inhabitants of a community. The thick blood-film examination of a large labor force or community on a single day does not, of course, disclose all of the individuals who may be positive for malaria. Interval surveys are indicated. The combined application of the blood and the spleen surveys would have greater value in the Latin-American labor forces, because the spleens of this race seem to show a greater degree and more permanent reaction to malarial infections than the spleens of the West-Indian negroes show. I think, however, that the thick blood-film survey, even in the Latin-Americans, will include nearly all of the malarial infections that are active.

5. The application of both the parasite and spleen survey methods will fail to detect all cases of malarial infections, as can be easily proved by the routine examination, at autopsy, of films prepared from the rib marrow and splenic pulp.

6. Of the 335 palpable spleens found in these adult negroes, only 71, or 21.2 per cent were below the costal margin. Of the 251 palpable spleens found in the negro children, 120 or 47.8 per cent were below the costal margin. The spleens which extended below the costal margin were not associated, in any regular manner, with the group of individuals showing "heavy parasite" infections in their blood films. These large spleens were very likely due to malarial chronicity rather than to 1 or 2 acute attacks.

7. Extreme cases of splenic enlargement, 1000 grams or more in weight, were not infrequent in the Latin-American labor class of the autopsy series; and they were very rarely encountered in the negro, even though in those who had lived for a number of years on the mainland under the same environment as the Latin Americans.

8. Analysis of the autopsy series of cases indicates that acute enlargement of the spleen in negroes is more significant and constant in typhoid fever and lobar pneumonia than in malaria of the aestivo-autumnal type.

9. The approximate range in weight of the normal spleen in these negroes is, apparently, 140 to 160 grams. (See Tables VII, XI and XVI).

10. It would appear, from an analysis of the clinical records associated with the weights of the spleen at autopsy, that in adults this organ must exceed 300 grams before palpation can score a very high rate of success (see Table IX).

11. The series of lobar pneumonia cases in the negro (Table VIII) revealed spleens with a weight in excess of 300 grams in 20 cases; yet, in 6 instances, or 30 per cent, these spleens were not palpable. A disease of this nature may interfere with a low excursion of the diaphragm, which would ordinarily force the spleen down; and an inflated stomach and intestine could further handicap efforts in palpation.

12. These series of cases, in the autopsy records on cases dying from some of the various causes of external violence, indicate that the approximate normal weight of the spleen in the West-Indian negro is 130 to 150 grams; while in 2 groups of 7 and 8 cases of the Latin-Americans, it was (for Panama and Honduras, respectively) 325 grams and 456 grams. A group of 12 white people from the United States gave an average weight of 122 grams; 2 adult Chinese men revealed an average weight of 80 grams. The body weight and height do not have as much relation to the size of the spleen as one might think. Race seems to play a more important rôle than the size of the body (see Tables VII, XI, XII, XIII and XVI).

It is not considered safe to assume that the average spleen weight given here for the Latin-American labor class is their normal spleen weight, even though the cases recorded were persons who were apparently in good health prior to the time they lost their lives as a result of some form of external violence. It seems probable that there is a more permanent reaction of the spleen to former or latent diseases in this race than in the other races mentioned. It may be true that the descendants of the African race do not respond to the malarial stimulus to the same degree as the natives of Central America. Perhaps this feature tends to show that malaria was imported to the Caribbean area during the days of slavery.

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MALARIAL HEMOGLOBINURIA*

EUGENE R. WHITMORE, M.D., D.P.H., F.A.C.P.

Professor of Parasitology and Pathology, Georgetown University
Medical and Dental Schools

Pathologist, Georgetown University Hospital, Washington, D.C.

Since my first experience with blackwater fever while serving in an extremely malarious region in the Philippine Islands, in the early days of the American Occupation, that condition has always interested me; and during my time as a student with Sir Patrick Manson that interest was aroused to a point where the condition presented itself as a fascinating problem to me. With the termination of my experimental work on bird malaria, I turned my attention again to malarial hemoglobinuria; and through the courtesy of Doctors Deeks, Connor, and Clark, I was able to undertake the study of blackwater fever in the Banes and Preston divisions of the United Fruit Company, and to visit Jamaica and Panama for the purpose of collecting data on that disease there. I am indebted to Dr. J. R. Ariza and his staff at the Banes Hospital, to Dr. J. de la Guardia and his staff at the Preston Hospital, and to Doctor I. W. McLean, in Kingston, for every assistance in the work. In Panama, my long-time friend, Dr. William M. James, made arrangements that enabled me to go over a large amount of material there in the short time at my disposal. The other officials of the United Fruit Company in Cuba, especially Mr. Schuyler, Mr. Harty, Mr. Mitchell, and Mr. Trinler, and their staffs, also extended every assistance and courtesy, and enabled me to visit neighboring properties where I obtained valuable information.

The work was undertaken along two lines: (a) Epidemiological Studies, and (b) Laboratory Work. Only the epidemiological studies are reported here—and that in the nature of a preliminary report. The laboratory studies will be reported elsewhere.

In the earliest American reports we find the name Malarial Hematuria for the condition commonly known as Blackwater Fever, while a little later we find the name Malarial Hemoglobinuria for the condition,—evidence that the American observers have always considered that malaria is the cause of this condition. There is no need to enter into a discussion of the literature, or to discuss the various suggested causes of blackwater fever. My belief is, and always has been, in accordance with the belief expressed by Connor¹, and Deeks² and James,² in their reports from the Panama Canal Zone; and Thomson³ in

* The general problem of hemoglobinemia and hemoglobinuria has been discussed elsewhere.

1. Connor, R. C.: "Hemoglobinuric Fever in the Canal Zone," *Proc. Canal Zone Med. Assoc.*, 1909, p. 83.
2. Deeks, W. E., and James, William M., "A Report of Hemoglobinuric Fever in the Canal Zone," pub. by Isthmian Canal Commiss., Dept. of Sanitation, 1911, 177 pp.
3. Thomson, J. G., "Researches on Blackwater Fever in Southern Rhodesia," London School of Tropical Medicine, *Research Memoir Ser.*, Volume VI, 1924, 149 pp.

his report from Southern Rhodesia, that the condition known as blackwater fever is due to repeated attacks of malaria. Any doubt regarding the distribution of the condition, as far as the Philippine Islands are concerned, is cleared away by my experience there. In 1904 I treated two cases of malarial hemoglobinuria in the malarious region at Camp Stotsenburg: one case, a native woman, died in a typical attack, with suppression of urine; and the other case, an American soldier, developed a typical attack while in the hospital under treatment for malaria, and recovered after a severe illness. As I have discussed elsewhere, it is reasonable to suppose that hemoglobinuria can develop during the course of malaria, as well as during the course of some other diseases. It is not necessary that hemoglobinuria develop in every case of malaria, any more than it is necessary that hemoglobinuria develop in every case of syphilis, in order to prove the causative rôle of the disease. Comment concerning the part played by quinine is deferred until discussion of the distribution of malarial hemoglobinuria in the divisions where I worked.

I obtained information of only a few cases of blackwater fever in Jamaica; and my studies in Panama extended only to the findings of Drs. Deeks and James in their analyses of the cases which occurred there from 1905 to 1910. I obtained some interesting information during my studies of the condition in Cuba.

SUSCEPTIBILITY

Accepting the theory that malaria is the underlying condition in blackwater fever, and agreeing on the mode of transmission of malaria, it is necessary to look at the third side of the triangle—i.e., to search for an explanation of the occurrence of hemoglobinuria in some cases of malaria and not in all, which necessitates a study of the susceptibility of the population. I propose to discuss my studies along this line, under three heads: (a) Racial Susceptibility, (b) Family Susceptibility, and (c) Individual Susceptibility.

(a) *Racial Susceptibility*

It is agreed that there is a difference in the susceptibility of different races to a number of diseases: notably, yellow fever. There is considerable evidence of a racial difference in susceptibility to malaria; though, here, one must bear in mind that this is probably no more than a difference in susceptibility to the clinical manifestation of malarial fever and not to positive infection with the malarial parasites. All studies of blackwater fever are in agreement that some races of people are more susceptible than are others; and this is usually explained as the development of a relative immunity to malaria (and so to malarial hemoglobinuria) after prolonged residence—probably generations, for a racial immunity—in the malarious region. We shall have occasion to return to this point.

TABLE I

COMPOSITE TABLE OF MALARIA AND HEMOGLOBINURIC FEVER RATES IN THE CANAL ZONE, 1905 TO 1910, FROM DEEKS' AND JAMES' TABLES IV, V, AND VII

Year	Annual Average Number of Employees	Number of Cases of Malaria per Year Discharged from Ancon Hospital		Malaria Rate per Thousand, Based on Total Number of Malaria Cases Discharged from Ancon Hospital	Number of Deaths per Year from Malaria	Death Rate per Thousand per Year from Malaria	Number of Cases of Hemoglobinuric Fever per Thousand per Year
		Total Number of Cases Discharged	Number of These Cases Positive				
	A. — AMERICANS						
1905	—	—	—	—	—	—	3.30
1906	5,464	—	—	—	7	1.33	1.9
1907	6,706	—	—	—	3	0.44	0.7
1908	6,572	1,004	262	152.8	4	0.60	0.39
1909	6,056	1,163	267	192.	0	0.	0.48
1910 to Sept.	—	571	169	—	—	—	—
	B. — EUROPEANS						
1905	—	—	—	—	—	—	5.
1906	2,000	—	—	—	?	?	5.5
1907	4,000	—	—	—	30	7.5	1.25
1908	5,811	3,786	2,598	651.5	25	4.25	5.88
1909	5,606	2,658	1,770	474.1	14	2.33	11.36
1910 to Sept.	—	1,885	1,128	—	—	—	—
	C. — NEGROES						
1905	—	—	—	—	—	—	0.33
1906	26,500	—	—	—	211	7.8	0.59
1907	28,634	—	—	—	146	5.11	0.28
1908	31,507	3,747	2,309	118.92	25	0.77	0.
1909	35,505	5,159	3,160	145.3	25	0.70	0.25
1910 to Sept.	—	2,776	2,025	—	—	—	—

Table I is a composite of the malaria and hemoglobinuria figures for American, European, and negro employees in the Canal Zone from 1905 to 1910, as contained in Deeks' and James' report. It will be noted that the malaria and hemoglobinuria rates are much higher in the European than in the negro employees. It is probable that the low rates for the American employees were in great part due to better living conditions enjoyed by them, and also to the high labor turnover among American employees. Deeks and James, in their

Table VIII (p. 33), tabulate 232 cases of hemoglobinuria, of which 33 are Americans, 148 are Europeans, and 51 are negroes. From Appendix A (page 77) of their report it appears that included among the Americans in Table VIII are one Panamanian, one Mexican, one Colombian, and one Chilean (25 cases are tabulated as Americans in Appendix A.) Spaniards make up 112 (76.62 per cent) of the cases among Europeans; and the cases among negroes are divided as follows: Barbadians, 28 cases (54.9 per cent); Jamaicans, 12 cases (23.53 per cent); Guadeloupeans, 1 case (1.96 per cent); and other West Indian negroes, 10 cases (19.61 per cent).

TABLE II

CONTRACT LABORERS BROUGHT TO THE ISTHMUS BY THE ISTHMIAN CANAL COMMISSION

Country	1904	1905	1906	1907	1908	1909	1910	Total
Spain	—	—	1,181	5,291	1,750	—	—	8,222
Cuba	—	—	500	—	—	—	—	500
Italy	—	—	909	1,032	—	—	—	1,941
France	—	—	19	—	—	—	—	19
Armenia	—	—	14	—	—	—	—	14
Total Europeans	—	—	2,623	7,424	1,750	—	—	11,797
Barbados	404	3,095	6,510	3,242	2,592	3,605	—	19,448
Guadeloupe	—	—	—	2,039	—	—	—	2,039
Martinique	—	2,733	585	2,224	—	—	—	5,542
Jamaica	—	47	—	—	—	—	—	47
Trinidad	—	—	1,079	—	—	—	205	1,284
Curacao	—	—	23	—	—	—	—	23
St. Kitts	—	—	933	—	—	—	—	933
Fortune Island	—	—	361	—	—	—	—	361
Total West Indians	404	5,875	9,491	7,505	2,592	3,605	205	29,667
Costa Rica	—	244	—	—	—	—	—	244
Colombia	—	1,077	416	—	—	—	—	1,493
Panama	—	334	10	13	—	—	—	357
Not classified	—	—	69	—	—	—	—	69
Grand Total	404	7,530	12,609	14,942	4,342	3,605	205	43,432

Table II¹ shows the number of laborers brought to the Canal Zone by the Isthmian Canal Commission, for the years 1904 to 1910, inclusive. The annual reports of the Isthmian Canal Commission furnish comment on the labor conditions in the Canal Zone from year to year. Thus, in the report for the year ending December 1, 1905, it is stated that the unskilled-labor problem is serious; that they can get a sufficient number of laborers from near by, but

1. *Annual Report, Isthmian Canal Commiss., fiscal year 1910 (July 1, 1909, to June 30, 1910)*

must develop greater efficiency. In the report for the year ending December 1, 1906, it is stated that the experience with the negro laborers is very unsatisfactory, as they work only long enough to get sufficient money to supply their actual bodily needs. They settle in the jungle and live in shacks, raise enough food to keep them alive, and work only a day or two occasionally, as they see fit. The great problem is feeding them, as it is practically impossible to get them to take enough nourishment to provide the physical strength necessary to enable them to work efficiently. The experiment with laborers from northern Spain was very satisfactory—about 900 had been at work since January 1, 1906. It is here that the chief engineer is quoted: "Any white man, so-called, under the same conditions, will stand the climate on the Isthmus very much better than the blacks, who are supposed to be immune from practically everything, but who, as a matter of fact, are subject to almost everything."

In the report for the fiscal year ending June 30, 1907, it is stated that the labor problem is still unsolved; but bringing in other nationalities has improved the conditions and lengthened the term of service. The tropical labor is migratory; it was necessary to take on nearly 1,500 men a month to maintain the force of common laborers. In the report for the fiscal year ending June 30, 1908, it is stated that much unskilled labor was brought in, and the labor problem was solved. The labor turnover was rather high; and the skilled force (from the United States) is practically renewed every year. After this, the labor force was fairly stable; but, in the fiscal year ending June 30, 1910, about 60 per cent. of the American force changed.

From consideration of the comments from the annual reports, it seems that the negro labor was extensively exposed to malarial infection, and that the living conditions and nutrition of this class of labor were not good; yet the malaria rate and the blackwater-fever rate were much lower in the negro labor than in the European labor. There is no evidence of difference in susceptibility among the Europeans. Nothing can be determined regarding any difference in susceptibility among the negroes from different regions. Judging from the few Jamaicans imported for work in the Canal Zone it appears that nearly all of the Jamaican labor was local, and the number of Jamaicans in the force of negro laborers cannot be determined.

In Jamaica, reports of cases of blackwater fever were rare. Dr. McLean had seen four cases in Kingston: one case in a Chinaman, one case in a white woman, and two cases in mulattoes. Doctor Hargreave, of the Insular Medical Office, had seen two cases in the region of Montego Bay: both in whites, and both in the same family. I obtained no report of a case in a Jamaican negro.

The racial distribution in Cuba does not lend itself so well to tabular analysis: but the conditions there gave me the opportunity I sought: to study malarial hemoglobinuria in a white race, living their lives, for generations, in the region. The Cuban race is to a great extent Spanish, and Deeks and James classified Cubans as Europeans. The blood of the original Indian races probably played

a rather small part in the formation of the Cuban race, and the blood of the African slaves who were brought into Cuba from 1524 to 1887 has become amalgamated with the blood of the lower and middle classes of the Cuban race.

Hemoglobinuria is rare among the Haitians who are brought in for the cane-cutting season. There was one case in a Haitian in 1926, and one case in 1927. But, during about four months in the year, hemoglobinuria is fairly common among the Cubans in the same area. Among 14 cases and 24 subjects studied I saw one case (fatal) in a Cuban mulatto, and one case (fatal) in a Barbadian who had lived in Cuba for six years, had not been away from Cuba for five years, and had lived three years in the region where I studied. All other cases, and all subjects, were Cubans. Hemoglobinuria is very rare in the Jamaican negroes living in Cuba.

(b) *Family Susceptibility*

Conditions in Cuba are such that I was able to study the occurrence of hemoglobinuria in families; and some interesting information was obtained from studies along this line. Data concerning a few representative families are given:



FIG. 1—Photograph taken by W. H. W. Komp, in January, 1927, a few weeks after the family had moved to Julia. The man on the reader's right, next to the mother, died in his third attack of blackwater fever, in March, 1927.

A. *Families with Blackwater Fever*

1. *Feria Family* consisting of 16 persons. The family has lived in Tacajo Viejo for years; but during the past 2 years in Mejia and Julia.

The grandfather is 70 years old; has lived all his life in Tacajo Viejo. He has had much fever, but no blackwater. His wife and children have had much fever, but no blackwater.

The father, 46 years old, was born in Gibara, lived in Tacajo Viejo 39 years; came to Mejia 23 months ago (writing in August, 1927), and came to Julia 8 months ago. He has had much fever, but no blackwater. He has taken quinine whenever he has been afflicted with fever. His brothers and sisters have had much fever, but no blackwater. Two nephews (sons of a sister) had blackwater in Tacajo Viejo, in the spring of 1927.

The mother, 42 years old, lived in Tacajo Viejo until 23 months ago. She has had much fever, but no blackwater. She always took quinine for the fever. She has 3 brothers, all of whom have had much fever, and all had blackwater in Tacajo Viejo. She has 2 sisters; both have had much fever, but neither has had blackwater. (The husband of one of her sisters died of blackwater.)

The sons and daughters all have had much malaria.

One daughter (11 yrs. old) had blackwater twice (1 attack in Tacajo Viejo, in 1918, the other in Mejia, in 1926).

One daughter (15 yrs. old) had blackwater once (in Mejia, in 1926).

One daughter (16 yrs. old) had blackwater twice (in Tacajo Viejo, 1924; and in Mejia, 1926).



FIG. 2—Photograph taken in August, 1927. The man with the beard is the grandfather.

One daughter (17 yrs. old) had blackwater once (Mejia, 1925).

One son (9 yrs. old) had blackwater once (Mejia, 1926).

One son (12 yrs. old) had blackwater 3 times (once in Tacajo Viejo, 1919; and twice in Mejia, 1926).

One son (13 yrs. old) had blackwater once (in Mejia, 1926). He also had a relapse.

One son (18 yrs. old) had blackwater 5 times (twice in Tacajo Viejo, 1922 and 1924; 3 times in Mejia, 1926).

One son (21 yrs. old) had blackwater 3 times; died in 3rd attack. (Twice in Mejia, 1926; once in Julia, 1927).

That is, 4 daughters had 6 attacks, and 5 sons had 13 attacks. These 9 children had 19 attacks (not counting relapses), and all but 1 attack occurred in the past 5 years. Five attacks were in Tacajo Viejo, 13 attacks were in Mejia, and 1 attack was in Julia.

Of the remaining children

One daughter (4 yrs. old) never had blackwater.

One son (2 yrs. old) never had blackwater.

One son (8 yrs. old) never had blackwater.

One son (16 yrs. old) never had blackwater. He has had much malaria in Tacajo Viejo, Mejia, and Julia.

One son (21 yrs. old) never had blackwater.

The husband, wife, and all the children, have lived together and under the same conditions continuously. In Tacajo Viejo the man ran his own farm, and was subject to the same sanitary conditions as the other people in the region. In Mejia he lived in his own house, in a community within the United Fruit Company's property; but was not an employee of the company, and was not under the sanitary control of the Medical Department of the company. In Julia he is an employee of the United Fruit Company, lives in one of their houses, and is under the sanitary control of the Medical Department of the Company.

2. *Ramirez Family*, consisting of 7 persons residing in Deleite. The family has always lived there.

Neither the father nor the mother has had blackwater.

One son has had blackwater once.

One son had blackwater once, which proved fatal.

One daughter has had blackwater 3 times (2 relapses in the last attack).

Two daughters never had blackwater.

3. *Tamayo Family*. — The family lived in Deleite for years. Three brothers had families there. Two brothers have moved away from Deleite with their families; but one still lives there.

None of the 3 brothers ever had blackwater, and neither did their wives. In one family there were 5 cases of blackwater, and in each of the other families there were 4 cases of blackwater.

The family with 5 cases now lives in Banes. There are 12 persons in the family. Neither the father nor the mother has had blackwater.

One son had blackwater twice.

One son had blackwater once.

One son had blackwater once.

One daughter had blackwater once.

One daughter had blackwater once.

One son and 4 daughters never had blackwater: 2 of the daughters never lived in the malarious district.

The other 2 families were not readily checked up. A son in one of these two families was one of the blackwater patients I studied.

Dr. Tablada, at Central Tacajo, in the region of Tacajo Viejo, has attended a family recording 14 attacks of blackwater.

As soon as one begins to follow the distribution of blackwater beyond the immediate family, it becomes complicated and leads to remote portions of the country, where it is not easy to collect reliable data. In considering the family distribution of blackwater, one must bear in mind the possibility that malaria is a house disease, as suggested by James' studies and that blackwater may be more of a house disease than a family disease. Thus, in one family with several cases of blackwater, there was a history of a case of blackwater in a Jamaican servant of the family, in the same house. On the other hand, not all families have more than one case of blackwater; in fact, it is more common to have only one case of blackwater in a family. Thus, one of the cases I studied was in a family where the father, mother, 2 brothers, and 3 sisters had never had blackwater.

B. Families without Blackwater Fever

1. *Lopez Family*, consisting of 11 persons, residing in Deleite, where they have lived for 21 years.

The family consists of the father, mother, 6 sons, and 3 daughters. The members of the family have fever; and, as is the custom with families in the fever districts, take quinine. In the past year the district physician has been giving quinine injections, and the members of this family have been taking these injections.

No cases of blackwater have developed in the family.

2. *Rojas Family*, consisting of 9 persons, residing in Deleite, where they have lived for 21 years.

The family consists of the father, mother, 4 sons, and 3 daughters. The members of the family have fever, and take quinine. In the past year the district physician has been giving quinine injections, and the members of this family have been taking these injections.

No cases of blackwater have developed in the family.

One can not be sure that the fever in the "non-blackwater families" was malaria. However, these families lived next door to, or across the street from,

the "blackwater families"; and it is probable that most of the fever was malaria, in the "non-blackwater families" as well as in the "blackwater families."

(c) *Individual Susceptibility*

It has long been recognized that a person who has had one attack of blackwater fever is quite liable to have another attack—i.e., it is usually considered that one attack predisposes to another. Thomson tabulates the number of attacks in 83 cases he studied in Rhodesia. In the 38 cases and subjects I studied in Cuba, the number of attacks per person was as follows (relapses not counted as attacks):

One Attack	Two Attacks	Three Attacks	Four Attacks	Five Attacks
26	6	5	0	1

In persons coming from a non-malarious region, blackwater occurs most frequently within a year to 18 months after beginning residence in the malarious district; and this is simply an exemplification of the fact that chronic malaria is the underlying cause of blackwater. It is frequently stated that longer residence of an individual reduces the liability to blackwater. This is often explained as due to an acquired immunity to malaria, and so to blackwater; but the conditions in Cuba, with a population born and spending their lives in the malarious region, do not substantiate this idea. Blackwater is common in Cuban children; and reference to the tabulation of the Feria family will show a phenomenon which appears to be common in families born and raised in the malarious region—that blackwater is very likely to develop before the person is 20 years of age, if it develops at all. Undoubtedly this development in early life is associated with the early opportunity for the development of chronic malaria, and not with the age of the person. But, it is also noted in the Feria family (which again appears to be common in families born and raised in the malarious region), that some of these children lived in the malarious region until they were 16 to 18 years of age before developing blackwater. We find here, as elsewhere, the tendency for a person who has had one attack of blackwater to develop another attack, and no indication of the development of an immunity to malaria, and so to blackwater. Is it possible that we are dealing with a difference in individual susceptibility, and that the susceptible persons (as one would expect) develop blackwater after a sufficient period of chronic malaria; that the less susceptible develop it after a longer period of chronic malaria; and that the non-susceptible do not develop blackwater at all, regardless of the length of residence in the malarial community? These questions must remain unanswered; for the present, at least. The information discussed above does not indicate any evidence of a developed immunity to malaria, and so to blackwater, on prolonged residence in the malarious region, either in the Cuban race, the family, or the individual.

The further study of the individual involves a large amount of laboratory work; and, as stated in the beginning, this is to be reported elsewhere.

Quinine and Blackwater Fever

There are too many reports of quinine precipitating an attack of blackwater fever, especially in cases of long-standing malaria, for any one to doubt the possibility of this; and every one who has worked with the condition has seen cases in which he is satisfied that quinine precipitated the attack, though usually it is impossible to say whether or not the attack might have occurred in the absence of quinine. Cold will precipitate an attack, as is so frequently reported in cases of chronic malaria returning to temperate climates from the Tropics; and this indicates a relation of the condition to paroxysmal hemoglobinuria. There are also reports of fatigue precipitating an attack. In the nature of things, quinine would be the most frequent contributing factor to precipitate an attack, since quinine is always taken for malaria, or for fever, in the malarious regions.

But all who have worked with blackwater fever are sure that malaria is the primary factor responsible for the condition; and that generally the quinine is simply the last straw in the load, with the possible exception of the persons who are especially susceptible to quinine. Again, all who have worked with blackwater fever have seen cases in which malaria was the only factor present to precipitate the attack, in persons who have never taken quinine. The young man in the Feria family who died in his third attack of blackwater fever, had always steadfastly refused to take quinine, or any of the remedies containing quinine; and none of his attacks could have been precipitated by quinine.

Most physicians of large experience do not hesitate to use quinine in the treatment of malaria in known blackwater-fever subjects, though they are frequently conservative in their dosage. Many doctors treat their cases of blackwater fever with quinine. Doctor Tomayo told me that in his experience in Deleite he treated all cases of blackwater, as he did all cases of malarial fever with quinine; and he never had had reason to feel that the quinine had proved harmful. A brief reference to the case of one blackwater-fever subject at Deleite, while I was there, will demonstrate the point. The man had a record of 3 attacks of blackwater, and reported at the dispensary with a severe attack of malaria. He was given quinine orally, 10 to 12 grains a day, and the malaria cleared up, without the development of any condition simulating blackwater.

These varying conditions furnish the incentive for the splendid practice of being careful and conservative in administering quinine in cases, or to subjects, of blackwater, and of giving prompt and efficient treatment in cases of malaria. Quinine is used carefully in cases of blackwater with malarial parasites in the blood; and is withheld, at least until the blackwater is over, in cases without malarial parasites in the blood. We have a somewhat similar condition to deal with when pregnant women are suffering from malaria. This disease will produce abortion, and as a result, quinine has acquired the reputation of producing abortion, or at least, of developing a threatened abortion into an actual one. In such cases it is necessary to give quinine to control the malaria; and most

of us who have had extensive experience with malaria have seen threatened abortion stopped while the patient was receiving conservative doses of quinine.

Returning to the general proposition, it must be understood that the prevention of blackwater fever is based on the prevention of chronic malaria; and that quinine is the outstanding drug utilized in the treatment of malaria, and plays an important part in malaria prophylaxis in the Tropics. While the screening of quarters and prevention of breeding of mosquitoes are very important measures in malaria prophylaxis, it is necessary to treat every case of malaria promptly and efficiently; and quinine is the drug used. Furthermore, under some conditions it is frequently necessary to use quinine prophylactically over varying periods of time. Hence, an understanding of the intelligent use of quinine is necessary; and this is not everywhere apparent, judging by the manner in which quinine is administered at times.

The reduction in malaria and blackwater fever in the Preston Division of the United Fruit Company is splendid evidence of the part played by malaria control in the reduction of blackwater fever; and it is also testimony that the efficient use of quinine in the treatment of malaria, as well as in prophylaxis, is a satisfactory method of reducing blackwater fever. The one and only attack of blackwater in the Feria family after it came under the sanitary control of the Medical Department of the United Fruit Company at Preston was in the man who died, and who had always refused to take quinine. Of course, the excellent work in prevention of mosquito breeding has contributed a great deal toward the reduction of the malaria rate, and so the blackwater fever rate, in this division.

The conditions in Deleite are interesting evidence that the active use of quinine in the treatment of malaria, as well as the prophylactic use of quinine, is an efficient method of reducing the incidence of blackwater fever. During the blackwater season of 1927, and for 3 months prior to that time, the medical officer at Deleite used quinine injections intramuscularly in his fever cases, and administered quinine prophylactically by mouth. The malaria rate, as well as the blackwater-fever rate in the Banos Division fell from the highest recorded rate, in 1926, to the lowest recorded rate, in 1927. These rates are actual rate reductions, when the number of laborers in the district are checked. Of course, it will be necessary to observe the work longer before one is justified in concluding that the reductions in the malaria rate and in the blackwater fever rate are actually due to the vigorous use of quinine; but certainly no one could conclude from this reduction that the vigorous use of quinine has increased the blackwater-fever rate.

Remarks

No conclusions are drawn; and the study must be continued. Everything revealed in a study of the occurrence of blackwater fever in Cuba supports the belief that it is caused by neglected chronic malaria; and nothing observed

there is inconsistent with that belief. There are striking differences in racial, family, and individual susceptibility to blackwater fever in Cuba; but much more data must be collected and studied before final conclusions may be drawn. Everything supports the belief that the efficient and intelligent administration of quinine in the treatment of malaria, as well as its utilization when required in malaria prophylaxis, along with other methods of malaria prophylaxis, does not increase the incidence of blackwater fever, but that in fact it markedly decreases the incidence of blackwater fever.

NOTES ON BLACKWATER FEVER IN BANES HOSPITAL

BANES, CUBA

WALTER MENK, M.D.

Blackwater fever in the Banes Division shows epidemiologically the same features as have already been described, some years ago, by the American observers in the Panama Canal Zone (Connor,¹ Deeks,² James²). This disease in Banes has shown a marked tendency toward the same seasonal incidence as malarial fever. The apex in the incidence of blackwater fever shows a slight lag in time, as compared to the apex in malaria; this also confirms Canal Zone observations.

Aestivo-autumnal parasites, usually in scant numbers, have been found in the peripheral blood-films in about 50 per cent of our patients during the year 1927. We have never been able to certainly identify tertian and quartan parasites in any of these cases. Parasites were more frequently found in the cases that were suffering from the initial attack of blackwater fever than in those suffering a 2nd or 3rd attack, the percentages being respectively 58 per cent and 30 per cent. No piroplasma, spirochaete, or other type of organism was found in any case examined. Even though the parasites of malaria were not found in more than 50 per cent of these cases, this parasite index was decidedly higher than in the malaria surveys made in the field and hospital on the native Cuban population.

The race feature seems to be an important item in the occurrence of blackwater fever, since it is seldom observed in our large negro population during harvest season. These negroes form a large part of the population in the Banes Division, and they are more exposed to malarial infection than the rest of the population, as their very high parasite rate always demonstrates. Blackwater fever, as a rule, occurs in the Cubans of predominantly white extraction; in Spaniards who live in unscreened quarters in malarious districts over long periods of time; and, usually, in individuals who neglect treatment for malaria, or who are insufficiently

1. Connor, R. C., "Hemoglobinuric Fever," *Proc. Canal Zone Med. Assoc.*, 1909 (April 1909 to March 1910), Vol. II, pp. 83-94
2. Deeks, W. E., and James, W. M., "A Report on Hemoglobinuric Fever in the Canal Zone. A Study of its Etiology and Treatment." Pub. by Dept. of Sanitation, Mount Hope, C. Z., 1911.

treated for it. A number of cases may occur in the same family or the same house, but usually such cases are found to have developed with long intervals between cases, sometimes extending over many years. Exceptionally, more than one case will occur simultaneously in the same house or family. It rarely happens that a large number of cases of blackwater fever come from a small community within a period of a few weeks. The close association between malarial fever and blackwater fever, as shown by the seasonal incidence of the two diseases, is further attested by the fact that a successful control of malaria will at the same time correspondingly reduce the incidence of blackwater fever.

SOME CLINICAL OBSERVATIONS

Race. — The race distribution, as revealed by 42 cases in our hospital, was as follows: 37 cases in rural Spaniards or Cubans of white extraction; 3 cases in apparently pure negroes; and 2 cases in persons of mixed-Creole race.

Number of Attacks in the Cases. — In this series, 32 were suffering from their 1st attack of the disease; 8 were admitted for a 2nd attack; and 2 for a 3rd attack.

Age Incidence. — Of the 42 cases, 25 occurred in people who were between the ages of 11 and 30; 10 of the cases were more than 30 years of age; while 7 were less than 11 years of age.

Intervals Between Paroxysms of Haemoglobinuria. — In this series, the interval varied from 12 hours to 8 days.

Duration of Paroxysms of Haemoglobinuria. — This varied from 6 hours to 5 days. I have the impression that (in the severe, fulminating, fatal cases) long paroxysms of haemoglobinuria are often manifestations of repeated, short haemolytic waves. Certain discrepancies occasionally are seen between the color of the blood-serum and the color of the urine, which support this theory. In most cases the paroxysms of haemoglobinuria are marked by rises of temperature which return to normal as the urine again becomes clear. In a certain number of the severe cases that exhibit a continuous, or but slightly irregular, paroxysm of haemoglobinuria, the temperature subsides by lysis in from 3 to 8 days following the disappearance of black urine. New haemolytic attacks, before the temperature has returned to normal, are usually marked by more or less pronounced peaks of fever. The later haemoglobinuric paroxysms are not always accompanied by any rise in the temperature. Occasionally, during convalescence, one may see an elevation of temperature without apparent blackwater. Following in the wake of a severe attack of blackwater fever, there is some tendency to develop pyogenic infections with abscess formations. Also, it is wise to examine the peripheral blood for malaria parasites during the convalescent stage of a blackwater-fever attack and before the case is discharged, since an attack of malarial fever sometimes becomes manifest at this time, even though parasites may not have been found at any time during the attack of blackwater fever.

Mortality Rates. — The total mortality rate of this series was 23.8 per cent. Those suffering from an initial attack of the disease showed a mortality rate of 28.1 per cent, as compared to a rate of 10 per cent among those who had formerly suffered from 2 or 3 attacks. Children show a very low mortality rate.

Duration of Hospital Stay. — The average hospital stay of cases that recovered was 16 days, with a range of from 5 to 32 days. Most of the fatal cases that die after a short, fulminating course reveal striking evidence of cardiac exhaustion. Anuria was seen in only 1 of the fatal cases of this series; 3 other cases died with uraemic symptoms after a protracted course of blackwater fever.

Treatment. — Rest in bed and the abundant use of fluids by mouth and rectum constituted the major part of the treatment. Caffeine sodium benzoate was administered hypodermically, but our staff is somewhat skeptical regarding the value of this drug.

SOME LABORATORY NOTES ON THE DISEASE

Erythrocytes. — There is a rapid reduction in the total number of the red cells during the phase of the haemoglobinuric paroxysms. In severe cases the count may fall as low as 1,000,000 in a few days. The red-cell count gives a more accurate idea of the progress of the anaemia than the haemoglobin estimation (Tallquist), which may offer false values when made during the period while the blood-serum is deeply colored. There is immediate danger of death when the red-cell loss brings the total count of these cells down to a level as low as 1,000,000, even if there be no associated anuria. A thick blood-film shows a marked degree of basophilia in the advanced stage of the attack. The thin film prepared during the first few days of the attack shows polychromatophilia and anisocytosis; and, in severe cases, poikilocytosis is marked.

Occasionally basophilic stippling and chromatin dust were seen. A marked difference was observed in the staining properties exhibited by many of the red cells. Achromia and ghost cells were observed several times. *Corps en demilune* and Cabot's rings were occasionally found as early as on the 2nd and 3rd days of the disease. Howell's bodies were sometimes frequent in the later stages of the disease. Nucleated red cells were generally not found earlier than on the 4th and 5th days of the disease. The number of erythroblasts in the peripheral blood, at the peak of the blood crisis, sometimes reached 20 per cent of the number of the white-blood cells. Erythroblasts are not seen at all in some of the rapidly fatal cases.

White-Blood-Cell Picture. — In 14 cases, at various stages of the disease, 34 total counts and 38 differential counts were made. In the 1st stage of the disease, the count is usually normal. Later, in the course, reparatory phase, there is a tendency to leukocytosis, and some of the severe cases may yield a count of 18,000 or more. In the convalescent period, counts as low as 5,000 may be found. The differential count of the cells shows the following outstanding feature:

Even at the onset of the attack, a high percentage of immature neutrophils appear. They are not excessively increased in slight cases, but reach astonishing numbers in severe and fatal cases. They persist in large numbers until repair begins in the blood-forming organs. Lymphocytosis was at times found in cases with a low total count. Eosinophiles were usually absent during the peak of the haemoglobinuric periods. The mononuclears and transitionals showed wide variations in different cases. Excessive values for these cells, 17 to 24 per cent, were observed in only 2 severe cases during haemoglobinuria. In 1 of these cases, these cells were vacuolated and presented a picture suggesting erythrophagia.

Blood-Serum and Blood-Plasma. — The majority of these observations were made from January to June, 1927. The appearance of the blood-serum taken at the height of a severe haemoglobinuric attack is so characteristic that I could not imagine anything else being the cause of it than hemoglobinemia. Furthermore, the test for haemoglobin with benzidine has been very strongly positive in several of these cases. I obtained a positive reaction in a 1 to 1,000 dilution of one dark-red and one dark-brown specimen of blood-serum. Two normal control specimens of blood-serum were negative early in the series of dilutions. It would appear that the haemoglobin content should have been about 25 to 30 times higher in the blackwater fever sera than in the controls. There is sometimes a striking difference between the color of the blood-serum and the color of the urine most recently voided. This seems to be especially the case at the close of the period of black urine. One can usually predict from the color of the blood-serum what the color of the next voiding of urine will be. Of course, a urine specimen spontaneously voided can not always be relied upon to show this prediction. The presence of hemoglobinemia does not necessarily mean that haemolysis takes place in the free blood stream. Hemoglobinemia, *per se*, does not permit any conclusion regarding the organ or organs in which it originates. (See Chart A, page 117.)

Sedimentation Time of Red-Blood Cells. — The sedimentation time of the red-blood cells is decidedly decreased (Linsemeyer technique employed). Exceedingly low sedimentation time accompanies the progress of the blood-destruction phase in blackwater fever. The reading of the sedimentation time is very difficult because the upper level of the cell column is not a sharply-defined line. What should be a well-defined line or level is a hazy zone of turbidity that is made up largely of leukocytes and blood platelets, rather than erythrocytes. The same result obtained in this test is encountered in any severe anaemia. The sedimentation time was recorded 6 times on 3 cases of blackwater fever.

Complement Content of the Blood-Serum in Blackwater Fever. — This test was made 6 times in 3 cases. The Noguchi technique was employed. As the series was small, no definite conclusion can be drawn except that the duration of the intervals and the end of a haemoglobinuric period are not primarily determined by the disappearance of complement.

Meinicke Turbidity Reaction (M.T.R.). — This test was apparently not influenced in a positive manner by the blood-serum from any stage of a blackwater fever attack, except for a slightly positive tendency at the peak of the haemoglobinuric paroxysm. No strongly positive, non-specific reaction was found in the 16 cases examined.

CHART A

Series of 23 Simultaneous Comparisons in 15 Cases of Blackwater Fever.
The Color of the Blood-serum, Blood-plasma, and the
Urine Specimen Most Recently Voided—(1927).

Case Number	Day of Disease	Color of Urine	Color of Blood-plasma and Blood-serum
481	1st	Black	Red-wine color
532	2nd	Black	Dark red
532	4th	Dark brown	Brownish
732	3rd	Black	Slight brown
732	17th	Not noted	Slight brown
732	21st	Clear-Normal	Normal
780	2nd	Brownish	Brown
960	2nd	Red	Slight brownish
987	Peak of Haemoglobinuria	Black	Red-wine color
987	In convalescence	Normal	Normal
1,051	2nd	Black	Red-wine color
1,219	2nd	Almost clear	Slightly brownish
1,270	1st	Black	Yellowish-red
1,070	2nd	Black	Red-wine color
1,272	2nd	Black	Brown-red
1,272	4th	Normal	Normal
1,743	1st	Amber	Brown, slight
1,762	2nd	Black	Red-brown
1,762	5th	Normal	Brownish
1,809	2nd	Normal	Normal
1,809	7th	Dark	Red brown
1,809	22nd	Normal	Normal
2,076	2nd	Black	Brown

Very recently I have been able to determine, in a case dying from a fulminating attack of blackwater fever, the relative concentration of haemoglobin in the blood-plasma and urine:

CASE HISTORY 701, YEAR 1928

This attack occurred in a Cuban boy, aged 15 years. It was his 2nd attack of the disease. His blood film was negative for parasites. The death occurred on the 1st day of the attack. The blood-plasma and blood-serum of the patient, taken about 15 hours before death, were of a dark-red or ruby-red color. The sedimentation time was extremely short. The urine at the time the blood specimen was taken represented a typical specimen of blackwater-fever urine. The blood-plasma and the urine of this case both gave a strongly positive benzidine test. This test remained positive in both specimens (blood-plasma and urine) in a dilution of 1:5,200. The benzidine test was slightly more intense in the blood-plasma dilutions. Two control plasmata from other patients not afflicted with the disease were negative in 1:40 dilutions.

SECTION III

NEOPLASTIC OBTURATION OF THE SMALL BOWEL,
COMPLICATED BY MULTIPLE INTUSSUSCEPTION

REPORT OF A CASE IN A CHILD TWELVE YEARS OF AGE

A. A. FACIO, M.D., F.A.C.S.

United Fruit Company Hospital

Limon, Costa Rica

Unusual Features. — This case is of interest, not only because of the comparatively uncommon metastatic occurrence of sarcomas in the small intestine—secondary metastases usually taking place in the liver—but also on account of the unusual type of intussusception produced by the presence of the tumor.

On October 13, 1927, I was called into consultation to see a boy 12 years of age, and the following history was given:

History. — In March, 1926, an inflamed blackish mole, the size of a dime, had been removed from the hairy scalp of the patient's right parietal region. About nine months later, the lymphatic glands of the cervical region of the same side commenced to swell; and, without obvious symptoms of any kind of infection, they grew in size and number, from the mastoid region, to the clavicle and the median line posteriorly. In August, 1927, he had been operated upon by one of the leading surgeons of New York, and a number of sarcomatous glands had been removed. The operation was followed by the application of deep X-ray therapy. The patient made a quick and uneventful recovery; and, returning to his home, seemed to enjoy apparently good health until September 22, when he was taken suddenly ill, with symptoms of acute indigestion.

A purgative was given; but, although the bowels moved, the passage was small and caused him excruciating crampy pains in the left half of the abdomen, accompanied by a great deal of bilious vomiting. Remedies were given and local applications made, to control the pain and vomiting. The latter subsided for the time being; but the pain, although not so severe, persisted in association with symptoms of intestinal obstruction. He was able to take liquids and a soft diet, with only an occasional attack of vomiting.

In the meantime, purgatives were given to relieve the constipation; but these, instead of producing a movement, provoked vomiting, which was always of a bilious nature. Several enemas were given; and with the exception of the first one, which was effective, they did nothing but provoke the patient to vomit. On October 12, the child's condition grew worse, the pain in the abdomen became

more accentuated, and the vomiting was almost constant. In the evening he was given an enema, which produced a blood-stained, mucous discharge accompanied by tenesmus and severe vomiting. The attending physicians made a diagnosis of intestinal obstruction, which I confirmed.

It was surprising to note that, notwithstanding the long course of the disease, the patient's general condition was apparently good. There was considerable tenderness all over the abdomen, with spasmodic contraction of the muscles but practically no distension. A movable and very painful tumefaction, the size of a small orange, was easily felt and outlined in the upper part of the left, lower abdominal quadrant. The patient was immediately removed to the hospital. There was no fever, and the pulse rate and respirations were normal. The blood count showed 18,700 leucocytes, and 79 per cent polymorphonuclear cells.

First Operation at Our Hospital. — At operation we found in the ileum the pathological picture grossly represented in the schematic drawing, Fig. 1, below.

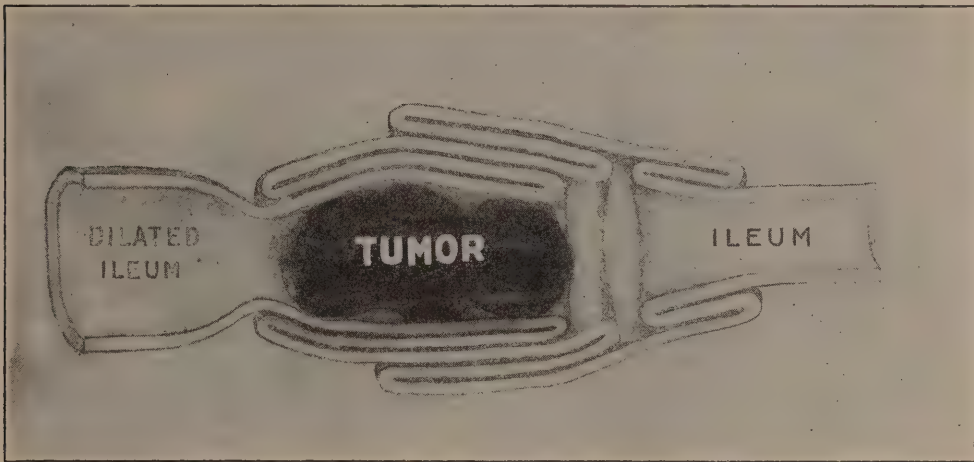


FIG. 1.—Scheme showing the tumor mass and formation of multiple intussusception of the Ileum, two descending and one ascending invagination

The tumor, which had blocked the entire lumen of the bowel, had provoked, through the force of peristalsis in an effort to dislodge and expel it, a double descending invagination; and the antiperistalsis, excited by the vomiting and aggravated by the enemas, forced the distal end of the intestine into an ascending invagination in the already distended bowel.

Under careful manipulation, and not without difficulty, the invaginated intestine, whose walls had already begun to adhere to each other, was released. The invaginated ileum, when uncoiled and straightened out, measured 30 cm. Some blood-stained fluid was expressed through the neck of the upper intussusception; but fortunately the walls of the intestines, which were inflamed and infiltrated, were not damaged in the procedure. The proximal end of the ileum

was dilated to double its normal size, and this extended upward to a length of about 60 cm. It was greenish in color, and had lost a great deal of its natural glistening appearance. The mesentery, at the site of the intussusception, was very much infiltrated, and contained a number of inflamed glands. A fixed tumefaction was palpable within the bowel.

An enterostomy was performed; and a black, polypoid, mushroom-shaped tumor, projecting into and blocking the entire lumen of the intestine, was found. It was adherent to the intestine at its mesenteric attachment, and involved the mucosa and muscularis, but not the serosa. The history of the case prompted a diagnosis of metastatic sarcoma. A resection of the intestine was considered; but owing to the high mortality from such an operation in children, and believing that nothing could be gained by this procedure, as rapid recurrence is the rule, the operation was limited merely to the excision of the tumor.

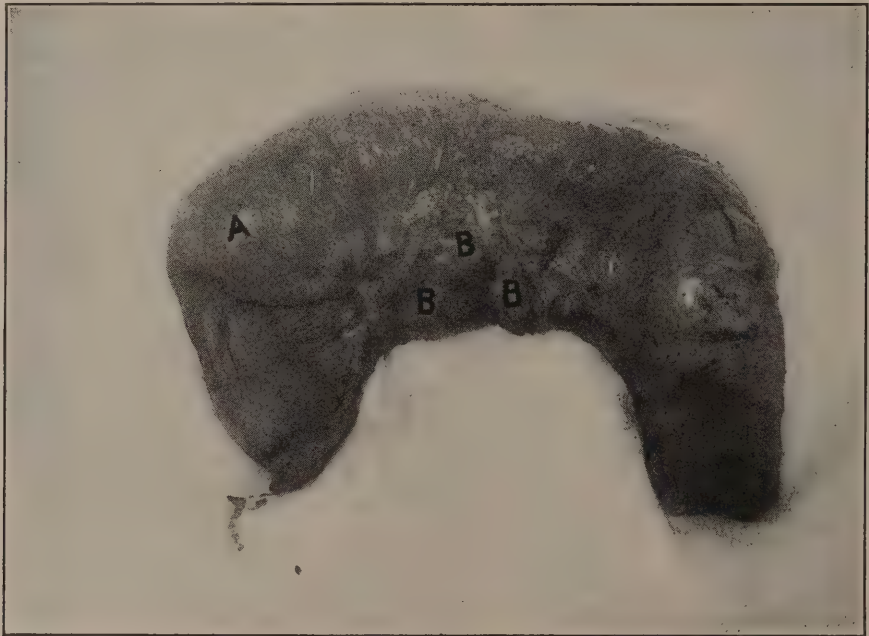


FIG. 2—Showing the Non-reducible Intussusception of the Ileum (A) and Enlarged Glands in the Mesentery (B)

Temporary Recovery. — The patient made an uneventful recovery. All the symptoms disappeared, and 3 days after the surgical intervention he had a spontaneous bowel movement consisting of well-formed faeces. He developed a ravenous appetite, and thoroughly enjoyed his food; and, when discharged from the hospital, October 24, he had gained 4 pounds. Unfortunately (and this was to be expected), the amelioration of the symptoms was only transitory. Fifteen days afterward the inflammation reappeared in the cervical glands and was

followed 2 days later by an equal, but more aggravated, picture of the abdominal condition described above.

Second Operation. — The child became gradually worse, and suffered greatly; and, at the request of his parents, it was decided to do a resection of that part of the intestine comprising the tumor-bearing area. This was done to satisfy the parents and to alleviate the child's intense suffering.

Fatal Termination. — The patient supported the operation surprisingly well, and had an uneventful day; but at 7 o'clock in the evening, when we all had begun to entertain hopes of a recovery from the second operation, the child developed a post-operative shock, and died within an hour's time.

Comments. — The site from which the first intestinal tumor had been removed, although very much indurated, was healed. Two other tumors were found; one blocking the lumen of the bowel, and another smaller one, both complicated by

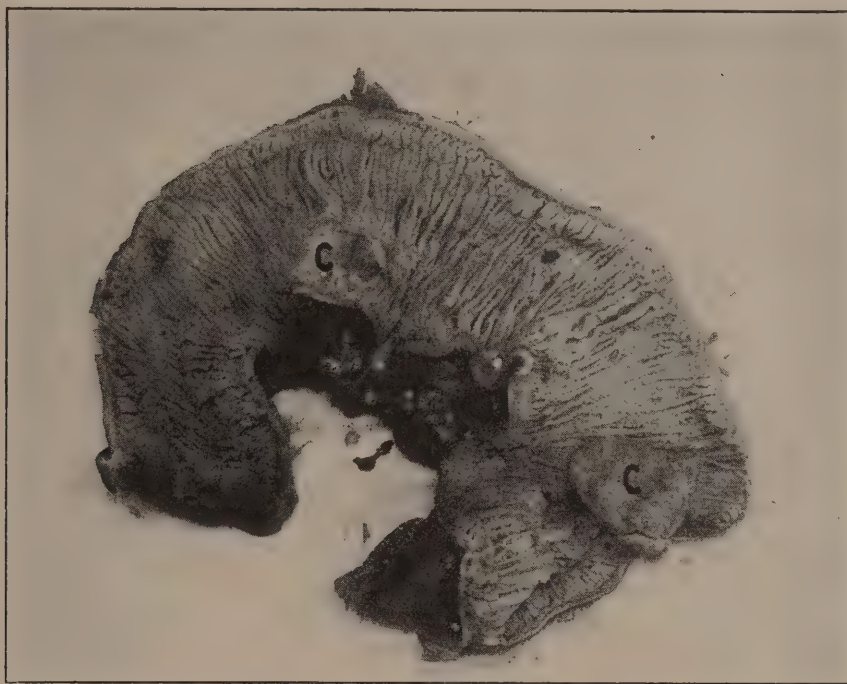


FIG. 3.—Showing Sarcomatous Masses in the Ileum (C, C)

single and separate intussusceptions (as shown in Fig. 3). There was also an intense inflammatory infiltration of the mesentery, which contained a large number of sarcomatous lymphatic glands (see Fig. 2, page 120, which shows the tumor mass involved in the intussusception).

The histopathologic examination was made by Dr. F. B. Mallory, who reported as follows:

Microscopically shows a vascular oedematous tumor composed of spindle to round cells; a few of the latter are large. Mitotic figures present in small numbers. No pigment seen. Diagnosis: Sarcoma, type not determinable, probably metastatic. May be a non-pigmented melanoblastoma, or possibly a rhabdomyosarcoma.

Sarcoma is the malignant neoplasm of early life, although it attacks the human body irrespective of age; whereas carcinoma is the tumor of adults. Bland-Sutton* states that it is worthy of note that sarcomas attack those organs of the stomach and intestines which are in a measure respected by carcinoma. Thus, in the stomach, sarcomas prefer the body of the organ; and they occur with greater frequency in the small, than in the large, intestine. In the small intestine the liability to the disease increases from duodenum to ileum.

FROIN-NONNE SYNDROME IN SPINAL FLUID

CASE REPORTS

WALTER JANTZEN, M.D.

Truxillo Railroad Company Hospital
Puerto Castillo, Honduras

During the last three years we have had two opportunities to see the Froin syndrome in the cerebrospinal fluid. When it is present the cerebrospinal fluid is yellow or greenish-yellow, and under normal pressure. The albumin in the fluid is enormously increased (tests made in saturated ammonium sulphate solution). The fluid usually has a strong tendency to coagulate when removed by lumbar puncture. The number of cells is normal, or very slightly increased. The Froin syndrome is found when a tumor or abscess of the spinal cord or vertebral column presses on the dural sac. These lesions are rare, but they appeared very clearly in one of our cases and the presence of the Froin syndrome enabled us to make an early diagnosis so that the spinal pressure could be relieved by an operation.

CASE REPORTS

Case 1 (No. 16,941). — A Jamaican negro was admitted to the hospital on May 20, 1925 complaining of having had persistent pains in the back for about 10 days; with fever and chills on 2 occasions previous to admission.

Physical Examination. — He was a well-developed and well-nourished man. The superficial glands were generally enlarged. There was pain on pressure over the regions of the kidneys. The temperature, pulse and respiration were respectively 100, 94, and 20. No other abnormal findings were revealed.

Symptoms. — The day following admission his temperature became normal, but it rose again to 101° on May 26, when his condition became worse. He complained of severe pain in the region of the os sacrum, and inability to urinate

* "Tumors Innocent and Malignant," Sir John Bland-Sutton, Cassel & Co., Ltd.

or to move his legs. His bladder was distended. The leucocyte count was 20,250, and the differential count revealed: polynuclears, 70%; small lymphocytes, 19%; large lymphocytes, and mononuclears, 7%; eosinophiles, 3%; basophiles, 1%. His urine was negative. The stools contained the ova of *uncinaria*. On May 28 his temperature was irregular, going as high as 102°. Paraplegia was present, and there was complete loss of sensation below the level of the 8th thoracic vertebra. The patellar, cremasteric and tendo Achillis reflexes were absent, but the Kernig's sign, and the Babinski and abdominal reflexes were present. The lumbar puncture showed spinal fluid under normal pressure, of greenish-yellow color, and the globulin test was positive +++. The spinal fluid coagulated during the period of the examination. The cell count averaged 4 to 1 cmm. of the freshly-examined spinal-fluid specimen. The culture of the fluid was sterile.

Fatal Termination. — The patient died on June 7, 1925.

Autopsy:

Head. — There was an increased amount of cerebrospinal fluid in the ventricles, but otherwise no change was found.

Thoracic Cavity. — Some adhesions were found between the lungs and the thoracic walls, especially in the region of the left, lower lobe. This lobe also revealed an apple-sized area of consolidation and a purulent bronchitis. The heart was slightly dilated. On each side of the vertebral column there were 6 protusions containing pus which yielded a pure culture of staphylococci.

Abdominal Cavity. — This was normal.

Vertebral Column. — A large collection of yellow pus was found between the dura mater and the vertebral column, from the level of the 2nd thoracic to the level of the 2nd lumbar vertebra. The pia mater was smooth, and no pus was found between the dura mater, arachnoidea, and pia mater. The spinal fluid was clear. The inferior thoracic section of the spinal cord was softened for a distance of about 3 cm. The body of the 12th thoracic and the 2nd lumbar vertebrae contained softened areas which communicated with the pus pockets.

Post Mortem Diagnosis. — (1) Osteomyelitis of the spinal column. (2) Compression of the spinal cord by an abscess. (3) Myelitis of the spinal cord. (4) Bronchopneumonia. (5) Purulent bronchitis.

Case 2 (No. 24,092). — An American, aged 19 years, was admitted to the hospital on October 5, 1927. He had had chills and fever for two weeks, and had taken quinine. He was delirious at intervals. His past medical history revealed no previous illness.

Physical Examination. — He was a well-developed and well-nourished white man. Temperature, pulse, and respiration were respectively: 104, 120, and 24. The blood film was negative for malaria. The specimens of the urine and stool were negative.

Symptoms. — On October 9, 1927, the temperature was 104 and the patient became delirious. The pupils were extremely dilated. Two days later he complained of some pain in the back. There was a slight rigidity of the muscles of the neck. The knee reflexes were exaggerated, but the Babinski sign was absent. There was weakness of the legs and also retention of urine. The leucocyte count was 27,000 and 91% were polynuclears. Pain was elicited over the region of the 7th thoracic vertebra when even slight pressure was exerted. An X-ray examination of the vertebral column did not show a definite lesion of the spine. A lumbar puncture revealed spinal fluid under normal pressure and green in color. The globulin test was positive +++. The spinal fluid coagulated during the period of its examination. The cell count in the spinal fluid averaged 10 white and 12 red cells to 1 cmm.

On October 13, 1927, the patient's general condition was the same. Lumbar puncture was again performed and a greenish fluid under normal pressure was found. The globulin test was positive +++. There was no rapid coagulation in this specimen. The cell count averaged 106 in 1 cmm. of the spinal fluid.

At the level of the 7th thoracic vertebra, there was slight swelling. Aspiration of this area revealed a deep collection of pus in the tissues.

Operation. — Vertical incisions were made along the lower thoracic vertebra. These incisions exposed abundant pus below the deep fascia which extended down to small rough areas of bone on the 6th and 7th thoracic vertebrae. This pus contained staphylococci.

Result. — On October 23, 1927, the patient's condition was better and the temperature was subsiding. The bladder regained its function and there was some movement of the legs. Lumbar puncture was repeated, and fluid of normal color and under normal pressure was found. The globulin test was positive +. The cell count in the spinal fluid averaged 21 in 1 cmm. A leucocyte count on the blood revealed 17,000.

Discharge. — The patient left the hospital, apparently cured, on November 27, 1927.

SUMMARY

Two cases are reported which showed the Froin-Nonne's syndrome. In both, the condition was caused by the pressure of an abscess on the spinal cord. In the fatal case, the abscess originated from an osteomyelitis of the vertebral body; while in the second case, the origin is not clear. The X-ray pictures did not show a lesion of the spine; nevertheless, it is quite probable that the abscess originated from the bones of the spinal column, as the operation revealed a rough surface on two of the vertebrae.

Apart from the clinical importance of these cases, the physiological side is interesting because the process of inflammation did not extend into the pia mater and the spinal fluid. The pia mater was absolutely smooth and the spinal fluid clear in the fatal case; while in the other case, only the spinal fluid obtained at the second lumbar puncture showed a slight increase in cells. Obviously, the dura mater is a strong barrier against the invasion of bacteria, and also against their toxins. The great increase of albumin and the yellowish color of the spinal fluid, attributed to blood pigment by Raven, can probably be explained by active and passive hyperaemia. The pressure of the abscess itself explains the clinical symptoms.

REPORT OF TWO INTERESTING SURGICAL CASES

J. R. ARIZA, M.D.

United Fruit Company Hospital

Banes, Cuba

Of interest in connection with these two case reports, is the article by Dr. Alfred Gage, published in our 1926 Annual Report, entitled "Machete Versus

the Microbe in Central America." Dr. Gage comments on the noticeable resistance of the lower-class laborers to infections from wounds in general, and especially those inflicted by the machete:

CASE No. 1

Case. — P. L. L., Spaniard, male, aged 37 years, a peddler.

History. — On March 22, 1927, at 6 P.M., while cleaning an automatic revolver, he accidentally shot himself in the abdomen. A remarkable feature of this case was that the patient came to the hospital without aid, and waited several minutes before he was examined, without fainting or showing any evidence of the severity of the injury.

First examination. — Abdomen was distended, but not very painful. About one inch to the left of the umbilicus there was a small round opening made by the entrance of the bullet. No external haemorrhage occurred. X-ray showed the bullet in the sacral region. A laparotomy was performed at 7.30 P.M., and the findings were: First, considerable haemorrhage into the peritoneal cavity; second, bullet track from above downward, and from the anterior to the posterior aspect of the body; third, four irregular perforations in the jejunum; fourth, three ragged perforations of the mesentery, with several small mesenteric arteries severed; fifth, five perforations in the rectum, in line, extending from the boundary with the iliac colon, down to the deepest part of the pelvic cavity.

All these injuries were carefully repaired, although the last perforation in the rectum was rather difficult to reach. The bullet could not be found. There were no faeces in the peritoneal cavity. A cigarette drain, reaching down into the pelvic cavity, was inserted.

The patient passed the bullet through the anus on the second day after the operation, and made an uneventful recovery in fifteen days. This man's recovery, without serious complications, can probably be ascribed to the fact that he had not partaken of food after a light breakfast at 8 A.M., and that his bowels had been thoroughly evacuated at about 2 P.M. The intestines were therefore empty, and easily handled; and there was no leakage of faeces into the peritoneal cavity.

CASE No. 2

Case. — V. P., Haytian, colored, aged 20 years, a laborer from a neighboring sugar plantation.

History. — On May 20, 1927, he was accidentally caught through the lower part of the abdomen by a basculating machine used for dumping cane. The patient entered the Baner Hospital on May 29. The abdominal skin showed two transverse bruises, running from right to left in the iliac region. Abdominal muscles were rigid. There was dullness all over the iliac and hypogastric regions. A hard mass was detected in the left iliac fossa, and smaller masses could be felt throughout the dull area. The left leg was paralyzed. The patient had been on a liquid diet before entering the hospital, and was passing very offensive, greenish, watery stools. On May 30, ten days after the accident, a laparotomy was done; and the following conditions were found:

When the abdomen was opened, a foul-smelling gas escaped. The peritoneal cavity was partially filled with liquid faeces, blood clots, and old liquid blood. There were extensive adhesions of the omentum and intestines, and the peritoneal surface of the abdominal cavity and intestines was covered with thick yellowish pseudomembranes. About six or seven inches of jejunum were gangrenous and had ruptured, and opened freely into the peritoneal cavity.

In the left iliac fossa, the intestines formed a mass which was covered with thick pseudomembranes.

The peritoneal cavity was cleansed as well as possible, and after a generous resection of the gangrenous portion of the intestines, an end-to-end anastomosis was done. Free drainage was established. On May 31, faeces were passing through the abdominal wound, which indicated that possibly the end-to-end anastomosis was unsuccessful. The surgical wound was reopened, and the abdominal cavity was carefully explored. It was then observed that the faeces were leaking through a very tiny opening in the intestinal mass in the left iliac fossa. It was not deemed advisable to attempt to repair it, as more harm than good might result from breaking up the dense adhesions in an endeavor to suture the opening in the intestine. Thorough drainage was established with large gauze sponges in the abdominal cavity, leaving the abdominal incision wide open. The drainage gauze was changed as it became soiled,—at first three and four times a day, then gradually less frequently, until it could be left in for a day without soiling.

The patient's improvement was gradual and uninterrupted, and after about a month the abdominal incision began to heal. The union was completely effected, by keeping the edges approximated with strips of adhesive plaster. The final result was a lineal scar. Late in July, the patient was able to walk. On August 15th, he left the hospital completely cured. The cause of the paralysis of the leg, which gradually disappeared, was not determined. The recovery of this exceptional and interesting case is ascribed to free and generous drainage.

A MAMMOTH OSTEOMA OF THE CALVARIUM

A. A. FACIO, M.D., F.A.C.S.

United Fruit Company Hospital

Limon, Costa Rica

It is interesting to observe, and presumably it happens everywhere, that a certain class of people, through fear or superstition, will endeavor to avoid surgery even when it is the only means available to alleviate their ailments or to rid them of ugly and deforming new growths.

The Nature of Osteomas. — These are innocent tumors, but may jeopardize the functions of the human body or become a menace to life when, by reason of their location and their continuous development, they exert pressure on a vital structure or impede the free movements of the bones at their articulations.

In some instances the formation of new bone tissue takes place after the fashion of normal bone, through the agency of osteoblasts or by a process of metaplasia. The hard osteomata of the calvarium are probably to be attributed to excessive local subperiosteal osteogenesis (Nicholls).*

* Nicholls, "American Practice of Surgery," Vol. 1, Bryant and Buck

Trauma Apparently an Underlying Factor. — It is not intended to enter into a discussion of the etiology of this class of tumors; but it does seem evident, judging from the history of the great majority of the cases that have come under the care of the author, that trauma is an underlying factor, indeed the chief factor in individuals already predisposed. It is possible that in the course of healing, through a process of traumatic inflammation similar to what happens with keloid formation, some of the cells are over-stimulated and continue to reproduce themselves—sometimes indefinitely. This appears to have taken place in the case reported herein, which seems to be confirmed by the none too rare development of bone tumors at the site of bone injuries. The author has at present under his care a case of osteoma of the crest of the ileum, which began to develop fourteen years ago as a result of a fracture of that bone.

Heteroplastic osteomata are attributed to misplaced cells of embryonic “rest,” but irritation or inflammation of some kind is, I think, necessary to stimulate the quiescent cells into a tumor formation. History seems to confirm this statement.

History of the Present Case. — When the patient was a baby eight months old, his mother, while nursing him, dropped him, and he sustained an injury in the occipital region. A solid lump, the size of a grape, remained at the site of the injury after the extravasated blood and inflammatory lymph had been absorbed; and this continued to grow “*pari passu*” with body development until it attained the present mammoth size. The patient is now 42 years of age. He states that the tumor developed very rapidly until he reached puberty; and its growth, while subsequently retarded, has not ceased.

The author first saw this patient fifteen years ago, and was naturally anxious to relieve him of the unsightly tumor and to prevent the possibility of its causing serious trouble in the future; such a suggestion, however, was met with a flat refusal. Superstition and fear determined the patient’s decision. A growth like that, people said, was a lucky omen; and he and his family were sure that a supernumerary brain was lodged within the tumor, and that any attempt at removal would surely cause death. Besides, the “double head,” as they called it, did not molest him much. It never pained when the other head ached, and for this reason he once declared that he would much prefer to have his real one amputated, retaining the one which gave him no trouble outside of a slightly uncomfortable sensation of weight and a feeling of the neck and head being pushed forward.

Operation, and Result. — The patient was lost sight of until the month of March, 1927, when he was admitted to the Limon Hospital with amoebic dysentery. He then complained of an uncomfortable feeling in the head; a tiring sensation of weight, with the feeling that the head was constantly pushing forward; and a



FIG. 1

limitation of motion. X-ray pictures were taken, and when he was convinced that the growth was nothing but a bony tumor, with no brain in it, he consented to the operation, which was successfully performed.

An "osteoma eburneum," hard as ivory and firmly united to and practically occupying the whole of the "squama occipitalis," was found; and, although a line of demarcation between the occipital bone and the tumor could be detected on the radiographs, the two were so firmly united that it was difficult at the operation to find out exactly where one ended and the other began.

With a great deal of patience, and with the aid of a chisel and mallet, the tumor



FIG. 2

was enucleated. It weighed two and a half pounds. Its dimensions can be easily appreciated by comparing the size of the tumor with that of the head as shown in the accompanying photographs. The patient made an uneventful recovery; all the annoying symptoms have disappeared; and he has returned to his usual work. Ten months after the operation, no sign of recurrence could be detected.

Conclusions. — The history of this case further confirms the theory of traumatism as an etiological factor in this class of bone tumors. Apparently the injury sustained when the patient was a baby provoked an excessive local subperiosteal osteogenesis, which gave origin to the new growth.

APPENDICITIS CAUSED BY *ENTAMOEBIA HISTOLYTICA*

A CASE REPORT

NOTES ON AMOEBIASIS IN COLOMBIA

L. M. DRENNAN, M.D.

United Fruit Company Hospital

Santa Marta, Colombia

Special Conditions in Colombia.—The physician who has had no previous training or experience in the practice of medicine in this country, especially on the coast, is frequently confronted by a variety of symptom-complexes new to him. The cure or relief of these conditions often taxes to no inconsiderable degree his ingenuity and resourcefulness, both from a diagnostic and a treatment standpoint.

This statement would seem far-fetched, if not ambiguous, to any one not possessing a working knowledge of the vagaries of *Amoeba histolytica*, which is commonly the causative factor here in many of the liver and gastro-intestinal disturbances included in the broad term, *amoebiasis*.

However, it is a well-established fact that intestinal amoebiasis, in the absence of dysenteric symptoms (constipation often being the rule), with lesions in the appendix, caecum, and, possibly, in the ascending colon, can be productive of as classical a case of either acute or, more especially, chronic everyday appendicitis as one could possibly wish to find.

Despite a knowledge of the many classical pictures of well-known acute and chronic abdominal diseases—such as gastric or duodenal ulcer, appendicitis, intestinal flatulency (old-fashioned dyspepsia), hepatitis, acute or chronic cholecystitis even to the extent of gall-stone colic—symptom-complexes which this particular parasitic infection may simulate—I am still strongly tempted, even in the presence of apparently clear-cut symptoms of these diseases, to question their real importance until the presence of *Amoeba histolytica* as a causative factor is absolutely and finally excluded.

Special Methods Advisable.—In arriving at a diagnosis of this disease—and I say disease because I think amoebic appendicitis should be classed as a separate and distinct entity—one should not depend merely on the ordinary, routine method of stool examination. Such cases can be given, with more or less safety, a thorough purgative of calomel and salts, or of laxative pills, and this is particularly indicated in the subacute or chronic manifestations. The second or third evacuation is usually selected for examination, and the reason for this is obvious. These organisms conceal themselves often in the folds, if not actually in the mucous membrane, of the bowel; and they are frequently absent from the first

evacuation, or so few in numbers as to escape recognition. Occasionally they are comparatively easy to find; but such a case should never be considered as negative for amoebiasis until every means for making the strictest search is exhausted. The reward for such thorough examination is often gratifying, and needless operations are avoided.

I admit that these statements cannot be made without reservation; but I have seen many cases of this type in the hospital and in the clinic recover so rapidly on a régime of emetin, bismuth, and a diet in which buttermilk or fer-millac plays a big rôle, that the results obtained would seem almost miraculous to the average doctor who has had no previous experience with such conditions.

An Illustrative Case. — The following case of rather acute appendicitis of amoebic origin, observed by me in the course of an operation performed for other causes, will serve to illustrate some of the points I have tried to bring out. This case is reported because of its unquestionably clear-cut etiological factors, supported by previous stool examination, by gross findings at operation, and by subsequent unmistakable microscopic evidence of the presence of amoebae in the lumen of the organ.

CASE REPORT

M. B., Colombian, married, housewife, aged 17 years, resided in the banana zone. *Family history,* negative. *Previous history.* — She had suffered previous attacks of vague abdominal colic at times in the past, but gave no history of real dysentery; and had had the fevers common to this region; the previous history was otherwise negative. She had given birth to one child.

History of Present Illness. — A well-nourished, rather unusually healthy-looking, young housewife, who was apparently not very sick. She admitted that for several months she had had pain and discomfort over the lower abdomen and back, accompanied by leukorrhoea, which was worse during menstrual periods. The pains had become more aggravated recently, and extended into the right side and down the thigh. She was nauseated, but never vomited. There was a slight increase in the frequency of urination, with some discomfort; and also vague pelvic pains, attending defecation.

On vaginal examination the uterus was found in retro-position, and fixed. There was some complaint of tenderness of both vaults, especially the right, where a tender mass about the size of an egg was palpated. A diagnosis of chronic pelvic inflammatory disease was made, and the patient was operated upon on the following day. At operation the following findings of interest were noted:—

When the abdomen was opened, through the usual median incision, plastic adhesions of the omentum and small intestine were observed attached to the pelvic genitalia. The uterus occupied a retro-position, bound down also by plastic adhesions which extended over both ovaries and tubes. The tubes were tortuous, occluded, and firmly adherent to the ovaries and pelvic walls posteriorly, showing every evidence of chronic inflammation common to infections of this character. Both ovaries showed evidence of multiple cystic degeneration, the typical picture of a burnt-out pelvic adnexitis. Following removal of the tubes and suspension of the uterus, my attention was directed to adhesions to the caecum and ileum which were apparent on the right side of the abdomen, rather high up. Gentle rupture of these adhesions dis-

closed in their bed an unusually long appendix, which was swollen and apparently inflamed. Some slight difficulty was encountered in removing it, because of the adhesions and surrounding inflammatory tissues. The abdomen was closed, without drainage. The patient made an unusually rapid recovery, and was discharged on the thirteenth day following the operation. A part of her post-operative treatment consisted of the daily administration of one-grain hypos of emetine.

The hospital laboratory reports, before and after operation, were as follows: *Urine*, negative; *stool*, uncinaria ova +, *Entamoeba histolytica*, +; *blood*, negative for malaria, *haemoglobin*, 80%. A microscopic examination of a smear from the lumen of the appendix immediately following the operation, showed *Entamoeba histolytica*, flagellates, blood, and pus. The appendix, prepared in Zenker's fluid and formalin, was sent to a reliable pathologist, who rendered the following report:

Gross. — The meso-appendix is fatty. The appendix has been opened from the proximal end to the tip. The mucosa and sub-mucosa appear thickened. No definite ulceration is seen.

Microscopic. — The interstitial tissue of the mucosa shows an extensive infiltration with wandering cells, and also many eosinophile leukocytes. There are some areas of necrosis of the inner part of the mucosa. The lymphoid tissue is hyperplastic. The submucosa shows an extensive round and wandering cell-infiltration. There is more than the normal amount of fibrous tissue. In the muscular subserous coats, and also in the meso-appendix, is observed a moderate round and wandering cell infiltration. Careful search of all sections fails to show entamoebae.

Diagnosis. — Chronic appendicitis.

Undoubtedly the method of preparation for shipment greatly lessened the possibility of finding amoebae in this specimen; but nevertheless they were of much interest and importance in this particular case.

COMMENT

(1) There was no previous history of real dysentery at any time. The patient had had vague abdominal cramps, confined more especially to the right side of the abdomen and not associated with vomiting, for a short period prior to hospitalization.

(2) The patient had recently suffered from constipation. Three laxative pills and an enema were necessary, on admission, to produce bowel movement.

(3) During the three days that she was in the hospital previous to the operation, the patient was on a soft diet. She was rather cheerful; had no fever; and did not complain of any particular pain.

(4) The benign character of the infection is indicated by the fact that, although it had evidently existed for days, if not weeks, there was not the slightest evidence of a tendency to gangrene or rupture of the appendix, which is normally expected very early in appendicitis, owing to the usual causes.

CONCLUSIONS

(1) Amoebiasis is a distinct entity and often associated with constipation. Symptom-complexes, simulating various abdominal diseases, are common in cases infected with *Amoeba histolytica*. No case presenting these symptoms should be operated on, or otherwise treated, until the examination of two or more stools fails to show the presence of this parasite.

(2) The comparatively short time in which most of the troublesome symptoms subside, when properly recognized and treated, is frequently remarkable.

(3) Appendectomy does not cure amoebiasis, which is a wide-spread colonic infection. The operation, therefore, should not be undertaken for this purpose.

(4) Relapses with amoebic infection are frequent; this is mainly on account of improper cooperation on the part of the patients, who have a tendency to discontinue treatment after a few days' relief from painful symptoms.

(5) No patient should be considered cured until free from all symptoms for a period of from six months to a year, or until repeated stool examinations fail to disclose the presence of amoebae.

(6) Infection can be avoided by boiling all drinking water, and by eliminating from the diet native-grown *raw* vegetables. Amoeba-carriers who are careless and uncleanly must not be permitted to assist in the handling and preparation of foods, particularly salads of raw vegetables and fruits, as such persons are common sources of infection.

(7) The value of making fresh-specimen stool examinations in such cases before operating, must be emphasized.

(8) There was undeniable evidence of the causative factor in the case reported in this paper, in the clinical findings, as well as in the gross and microscopic pathology.

RIGHT STRANGULATED INGUINAL HERNIA AND
APPENDICIAL ABSCESS, COMBINED

A CASE REPORT

E. W. DAVIS, M.D., and I. E. PEON, M.D.

United Fruit Company Hospital

Almirante, Panama

R. P., colored, aged 62 years, was admitted to the hospital, June 11, 1927, with an irreducible hernia, and complained of having had a severe pain of 3 days' duration in the lower right abdomen. He had taken 2 ounces of magnesium

sulphate, without results; was nauseated; and vomited several times. The vomitus was green and bitter, but not faecal. He had had occasional attacks of incarcerated hernia for a period of 2 years; but it had never descended into the scrotum, and had always subsided by itself when he was lying down. His family history and his past history had no bearing on the present illness.

Physical examination. — This showed a well-developed and well-nourished negro, apparently suffering intense pain in the lower right abdomen, with temperature 99°, pulse 110, and respirations 20. Except at the site of the hernia, the physical examination was entirely negative. *Abdomen:* There was a moderate degree of distention. Palpation revealed marked rigidity, tenderness, and muscle spasm over the entire lower right quadrant and extending downward to the inguinal ring. There was a protrusion of an indirect inguinal hernia through the right inguinal ring. The hernia was about the size of a small lemon, was very tender, and was irreducible. It did not descend into the scrotum.

Laboratory Findings

Urine: specific gravity, 1.024, acid reaction, faint trace of albumin, and a few granular casts; otherwise negative. *Stools:* Uncinaria ova present; otherwise negative. *Blood:* Negative for malaria; haemoglobin, 65%; white count: total 14,000; polys 76%, small 18%, large 3%, transitionals 3%.

Pre-operative Diagnosis. — Strangulated hernia; and, probably, acute appendicitis. *Comment:* The abdominal examination showed definite muscle spasm, and marked tenderness and rigidity over the entire lower right quadrant, which suggested a complicating acute appendicitis. However, the strangulated hernia was a recognizable condition, and it was decided to make the hernia incision first.

Operation (June 11, 1927). — The usual herniotomy incision was made. A small hernial sac was found, containing about three inches of strangulated ileum. The constricting band was cut, the intestine returned to the abdominal cavity, and the appendicial region explored through the opening. As the finger entered behind the caecum a gush of pus was encountered. Without any further disturbance, the hernial sac was isolated, tied high up, and cut off, after the method of Ferguson. One rubber tissue-drain was inserted down to the peritoneum, and another between the skin and the fascia. A low right rectus incision was made, and the intestines were packed off carefully with warm saline packs. The appendix was found to be moderately adherent, with very soft adhesions. It was easily delivered, and about 60 cc. of dirty, foul-smelling pus escaped. The outer third of the appendix was very large, red, hyperaemic, friable, and ruptured. The ilio-caecal lymph glands were enlarged, and the surrounding loops of intestines reddened and slightly adherent. The appendix was removed, and the stump inverted and cauterized. Two rubber tube drains were inserted, and the abdomen was closed in layers.

Pathological Report

Gross examination showed an appendix about $4\frac{1}{2}$ cm. long. Its proximal one-third was hard and fibrous, with complete obliteration of the lumen. It measured about 1 cm. in diameter at the proximal end, about 2 cm. at the distal end, and throughout the distal two-thirds was very red and necrotic, with a perforation about 2 mm. in diameter. It contained a small amount of pus, of very foul odor. A smear showed numerous cocci and bacteria, of which the *B. coli* predominated.

Result. — Notwithstanding careful post-operative treatment the patient developed general peritonitis, and died on June 16, 1927.

Autopsy

This showed the lungs to be normal; the heart muscle was soft and flabby, with no hypertrophy. The abdominal cavity was practically dry, and contained no free fluid nor pus. The peritoneum and all the intestines were covered with flakes of fibrin, of a dirty gray color, which peeled off easily. The intestines were distended and hyperaemic. The strangulated segment of the ileum was about three inches long, located at a distance of approximately two feet from the caecum. It appeared to be normal. There was no leakage from the appendix wound. The kidneys were small; the capsule in each stripped with difficulty; and, on section, the cortex of each was found to be narrowed and the fibrous tissue increased. The pelvis of each kidney contained a small amount of thin, cloudy pus.

Autopsy Diagnosis: (1) general peritonitis; (2) myocarditis; (3) chronic interstitial nephritis; (4) bilateral pyelitis; (5) arteriosclerosis; (6) uncinariasis.

A SIMPLE METHOD OF TREATING FRACTURES OF THE ELBOW IN CHILDREN

RICARDO AGUILAR, M.D.

United Fruit Company Hospital

Quirigua, Guatemala

The most frequent fracture of the elbow in children is that of the lower end of the humerus, with posterior displacement of the epiphysis.

A very simple and satisfactory method of handling these rather difficult fractures has been adopted as a routine treatment in the Quirigua Hospital. The simplicity of the procedure, and the practically uniformly good results, suggested the preparation of an illustrated paper describing this treatment. There are a few rules that should be carefully observed, and the results will be almost always satisfactory:

(1) Reduce the fracture at the earliest possible moment. Early reduction prevents oedema and needless pain and distress to the patient, and makes the surgeon's work easier.

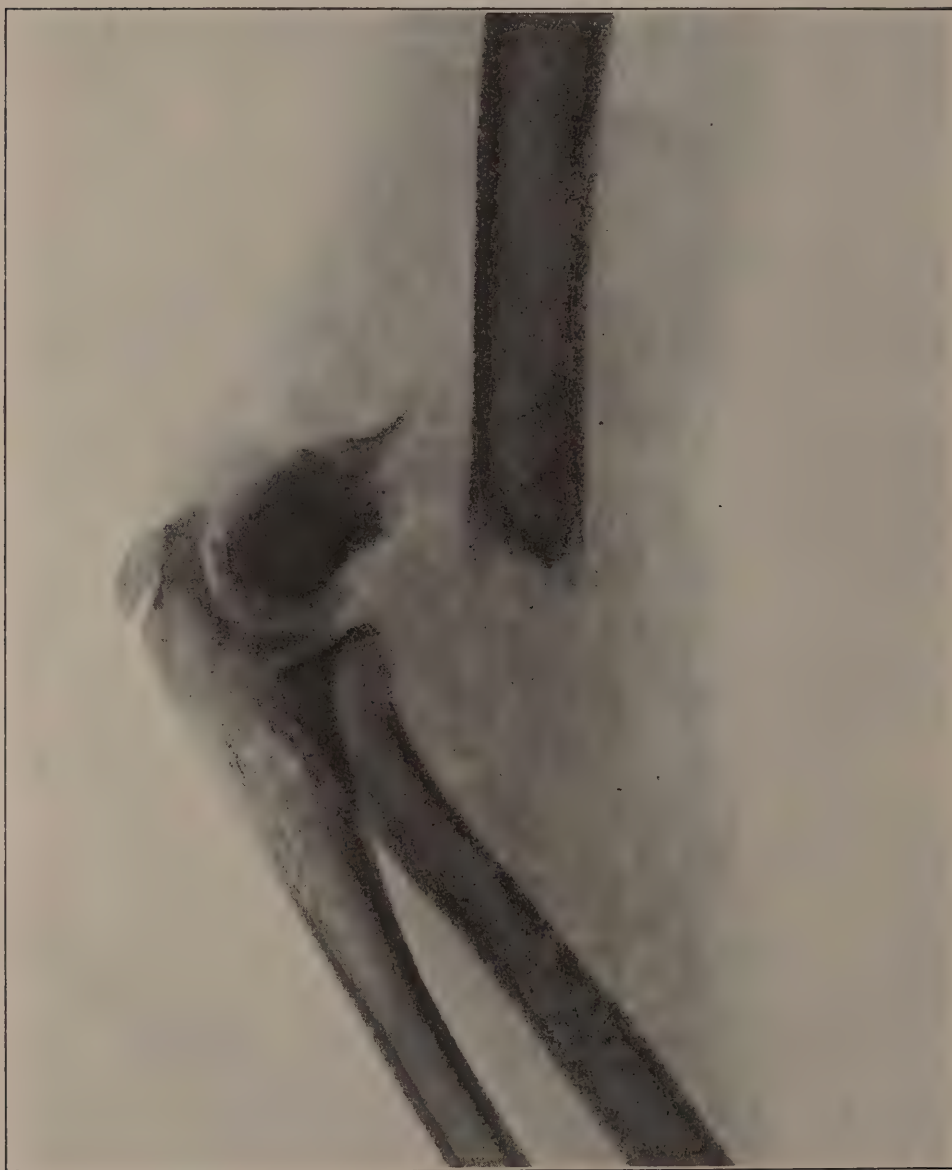


PLATE 1A—Showing Condition at Time of Accident (March 21, 1926)

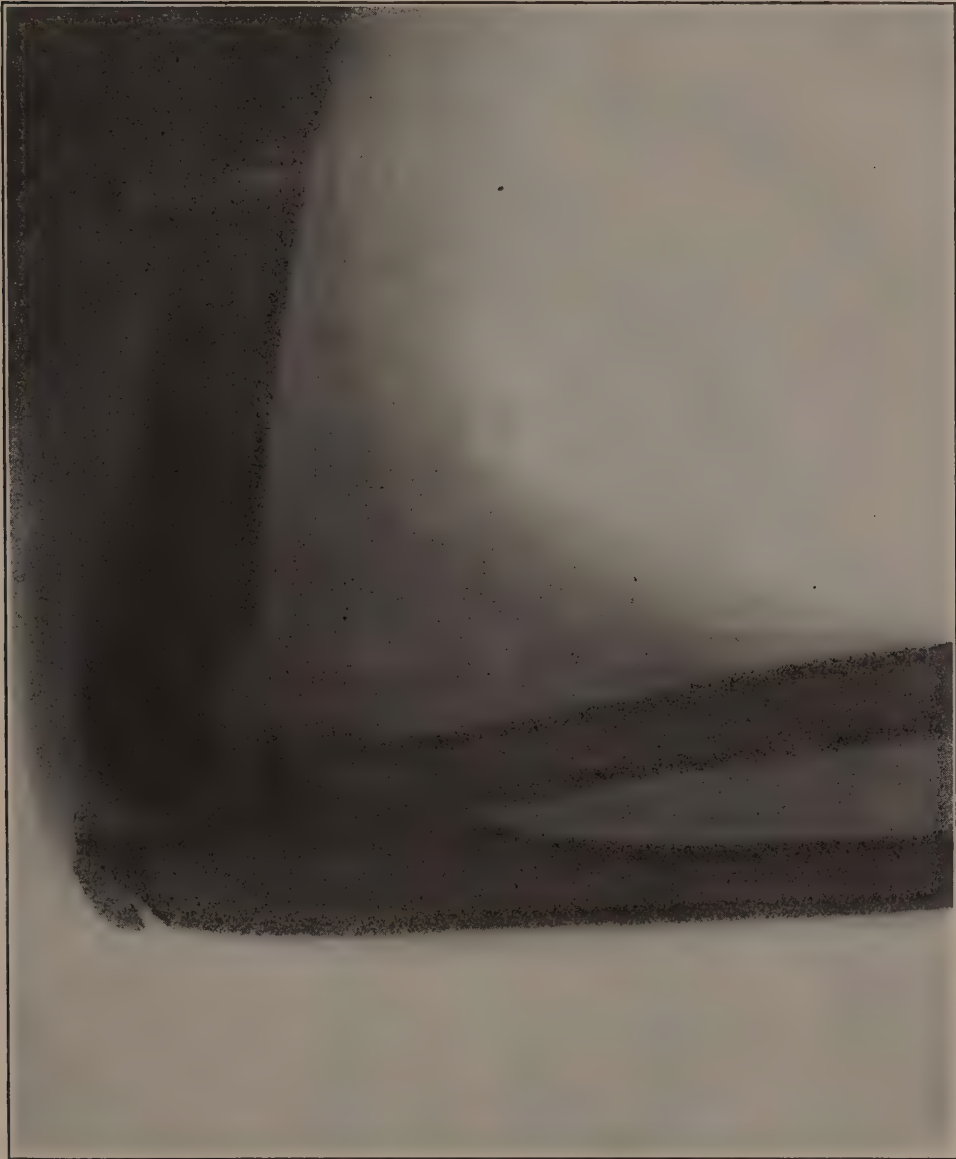


PLATE 1B—Showing Condition After Reduction (April 5, 1926)



PLATE 2A—Showing Condition of Elbow at Time of Accident

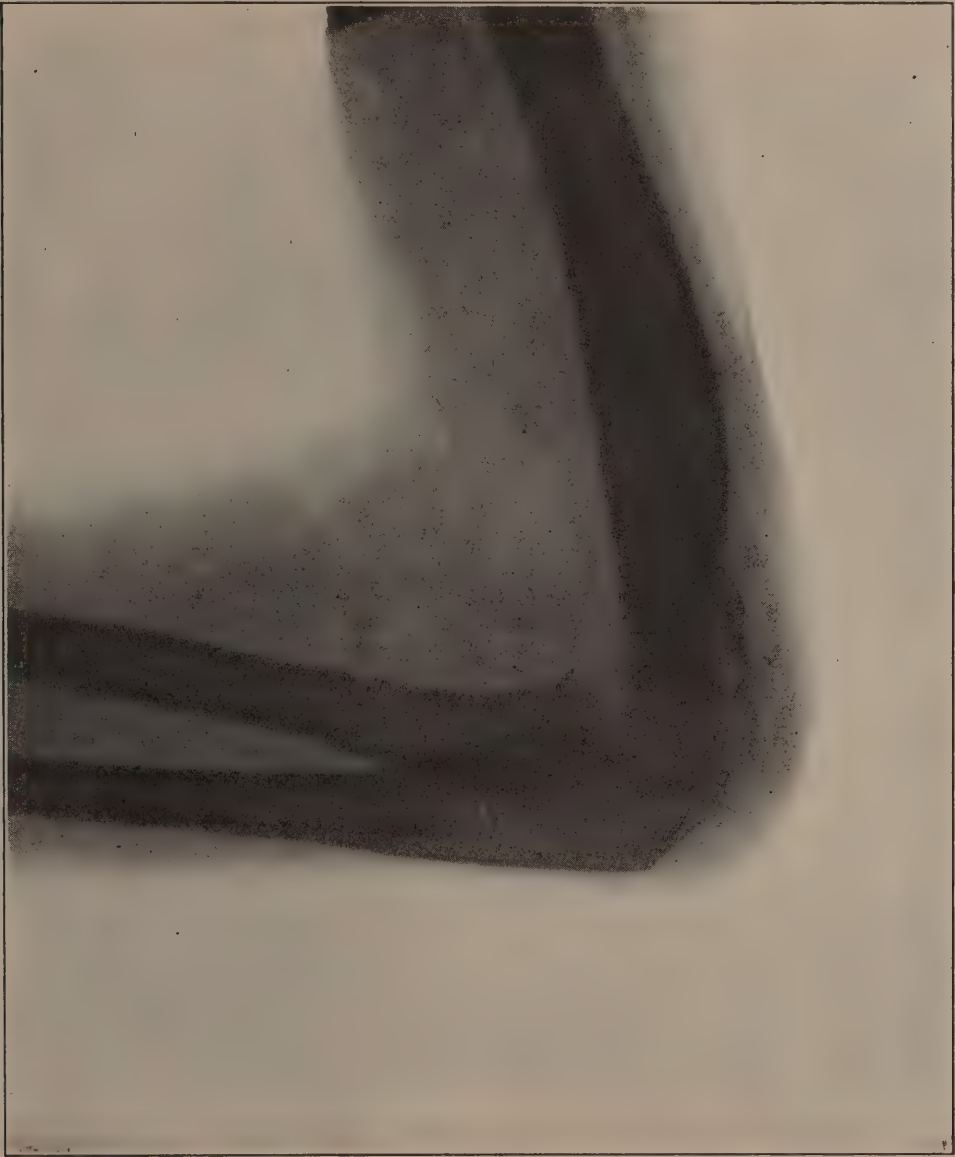


PLATE 2B—Showing Condition Two Years After Accident



PLATE 3A—Showing Condition of Elbow at Time of Accident



PLATE 3B—Showing Condition One Year After Accident



PLATE 4A—Showing Condition of Elbow Before Reduction



PLATE 4B—Showing Position After Reduction

(2) Give a general anaesthetic, and relax the tissues.

(3) Place the elbow in extreme flexion and supination. This position gives better approximation of the fragments and the highest degree of anatomical perfection.

(4) Use adaptable splints such as stiff cardboard. It is light and inexpensive, and easily removed when necessary. The cardboard splint should extend from the middle third of the arm to the middle third of the forearm, with the elbow in extreme flexion and supination. The cardboard should be wide enough to cover two-thirds of the circumference of the arm. Two oblique incisions are made in the cardboard, one on each side of the olecranon, so that complete adaptability can be obtained when the forearm is flexed. A small splint is adapted to the anterior surface of the arm and forearm, cut to fit accurately and not to overlap the other splint. When the fracture is reduced, and the forearm is placed in extreme flexion and supination, the splints are lightly covered with cotton, adjusted, and bandaged in "figure of eight" form. This holds the bones in position, and still permits the patient to have free movement of the shoulder and body. The greatest care must be taken to see that circulation has not been interfered with. Pain and swelling soon disappear when the arm is in a proper position.

(5) Early movement of the joint is essential, to prevent ankylosis. At the end of the 2nd week the arm is put in a sling, and daily passive movements are continued until complete power of movement is recovered. At the end of the 3rd week massage is indicated, and active movement is encouraged gradually. At the end of the 4th week full movement is permitted, and the sling is dispensed with.

CASES ILLUSTRATED BY ACCOMPANYING X-RAY PICTURES

Case No. 1.

History. — Boy, aged 10 years, fell over the back of a chair, and landed on his right arm. *Condition on admission.* — Characteristic deformity, with pain and swelling. *Treatment.* — The arm was put up in extreme flexion and supination, with cardboard splints. The splints were removed on the 16th day, a light massage was given, and the splints were replaced for 8 more days. No shortening or deformity occurred, and the functional results and anatomical restoration of parts were very good. The patient was discharged from the hospital on the 26th day. X-ray plates on pages 136 and 137 show the condition before and after reduction.

Case No. 2.

History. — Boy, aged 11 years, was thrown from a horse, and his left arm injured at the elbow. *Condition on admission.* — The arm was swollen considerably, and the deformity marked. There were pain and tenderness, and skin wounds around the elbow.

Diagnosis. — Fracture of the lower epiphysis of left humerus (fracture of elbow), with posterior displacement. *Treatment.* — Ether anaesthesia was administered, and the fracture reduced 4 hours after the accident occurred. Wet boric dressings were applied to the lacerated soft parts. The arm was placed in cardboard splints, in a position of extreme flexion and supination. The patient was discharged, by request, the following day, and reported every 3rd day for dressing. On the 17th day the splints were removed and a sling was substituted. Perfect anatomical restoration of parts and of functions was present on the 28th day. X-ray plates on pages 138 and 139 show the condition of the arm at the time of accident and 2 years later.

Case No. 3.

History. — Boy, aged 9 years, fell off a mule and injured his left elbow. *Condition on admission.* — The left arm was much swollen, the deformity at the elbow was marked, and the arm was painful and tender. *Diagnosis.* — Complete simple intracapsular fracture of the lower epiphysis of the left humerus, with posterior displacement, and 1-inch shortening. *Treatment.* — Reduction was made under ether anaesthesia, and cardboard splints were applied, with the arm in a position of extreme flexion and supination. The patient was discharged, by request, on the 4th day, but reported frequently for observation. The splints were removed on the 18th day, and a sling was applied. No permanent shortening occurred, and at the end of 1 month there was complete restoration of the functions and of the anatomical structures. X-ray plates on pages 140 and 141 show the condition of the elbow before reduction and 1 year after.

Case No. 4.

History. — Boy, aged 9 years, fell from a tree, injuring the right arm at the elbow. *Abnormal conditions.* — Deformity, swelling of arm, and pain and tenderness at elbow, were present. *Diagnosis.* — Complete fracture of the lower epiphysis of the right humerus (fracture of elbow), with posterior displacement, and a $\frac{3}{4}$ -inch shortening. *Treatment.* — Reduction of fracture under ether anaesthesia was accomplished 2 hours after the injury; and the forearm was fixed in a position of extreme flexion and supination, with cardboard splints. The patient was discharged from the hospital on the 7th day. He returned on the 15th day, when the splints were removed, and a sling was substituted. On the 30th day it was noted that the anatomical restoration and functional results were perfect. X-ray plates on pages 142 and 143 show the position of the elbow before and after reduction.

POPLITEAL ANEURYSM—A SURGICAL CASE REPORT

I. E. PEON, M.D.

Almirante Hospital, Almirante, Panama

R. P., Jamaican negro laborer, aged 45 years, well-developed and well-nourished, was admitted to the Almirante Hospital, September 27, 1927, suffering from pain and swelling in the right leg. The pain was considerably worse at night, but the swelling would subside by morning and return again during the day when he was on his feet.

History. — He had first noticed the condition about one year previously. It began with slight pain in the leg, and a swelling located in the right popliteal space. Both pain and swelling gradually became worse, until finally he was completely disabled and confined to his bed for 3 months prior to his admission to the hospital. At this time he was unable to completely extend the right leg, owing to a large pulsating tumor in the popliteal space, which extended 4 inches up the thigh and 6 inches down the leg. It presented 2 large protrusions; one in the mid-line, which was very tense and pulsating, with an apparent thin wall; the other smaller, located below but connected with the main mass, was lying in the upper part of the calf muscles. The circumference measurements of the legs were as follows: *Right*:—At mid-patella, 28 inches; 3 inches above mid-patella, 23 inches; 5 inches below mid-patella, 25 inches; *left*, at mid-patella, 15 inches; 3 inches above mid-patella, 14 inches; 5 inches below mid-patella, 13 inches. The pulsation of the tumor was visible, and synchronous with the arterial pulse wave, which in the dorsalis pedis artery was much weaker on the right than the left. On auscultation, a harsh bruit was heard over the entire tumor mass.

The patient had been married 15 years, and during this time his wife had had 1 living child and 3 abortions.

In 1910 he had developed a sore on the penis, which was delayed two months in healing. At this time he noticed no secondary eruption of syphilis, but did have nocturnal headaches and bone and joint pains. There was no history of injury. The Meinicke test for syphilis was strongly positive.

Diagnosis and Operation. — A diagnosis of tertiary syphilis with aneurysm involving the right popliteal artery, was made.

Operation according to Matas' technique was performed on September 30: A tourniquet was applied well above the tumor, and an incision 12 inches long was made in the mid-line of the popliteal space, extending 5 inches up the thigh and 7 inches down the leg. When the skin and subcutaneous tissues were separated from the aneurysmal sac, it was found that the covering over the middle portion of the tumor was closely adherent to the thin sac wall and required careful dissection to free it. The aneurysmal sac was opened and a large amount of clotted blood was removed, the outer layers of which were quite adherent to the

friable sac wall. Gradually the sac was obliterated, layer by layer, with fine silk and No. 0 chromic catgut sutures. The tourniquet was then gradually released, and it was found that bleeding was controlled. The mass of the obliterated sac formed quite a tumor in itself. The skin incision was closed with interrupted silk-worm gut sutures, dressing applied, and the entire leg enveloped in a thick pad of absorbent cotton.

Progress of the Case. — The patient was put to bed with the head elevated about 6 inches, and the leg was surrounded with hot water bags, supplemented with an improvised electric bath. The radial pulse was 144. Pulsation could be faintly detected in the dorsalis pedis artery. At 8 p.m. the radial pulse was 134 and the temperature 101° F.; he was free from pain. The following day the leg was warm, pulsation in the dorsalis pedis artery could be distinctly felt, and he continued free from pain. The subsequent progress was satisfactory until October 5, when the temperature rose to 103° F. Examination of the wound revealed a stitch abscess, which was evacuated. One week later the discharge from the wound had ceased, the temperature had become normal again, and recovery was uninterrupted.

He received intravenous injections of arsphenamine, commencing five days after the operation. This treatment was supplemented by potassium iodide in increasing doses.

On November 9, 42 days after the operation, the patient was allowed out of bed with crutches. He could stand on the right leg, and felt no pain. The leg was still slightly swollen, and the superficial veins were engorged. The crutches were discarded on November 14, and he was able to walk without pain, and with free and complete motion of the knee joint. On November 28 he was discharged from the hospital. Circumference measurements on this date were as follows: Operated leg, mid-patella, 16½ inches; 3 inches above mid-patella, 14½ inches; 5 inches below mid-patella, 14 inches.

The wound was perfectly healed; there was no limitation of motion at the knee, and no swelling of the leg after walking.

FRACTURE OF THE SCAPULA—CASE REPORT

B. M. PHELPS, M. D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

Fractures of the scapula are rare, owing to the mobility of the bone, the thick layer of muscles by which it is protected, and the flexibility of the ribs on which it rests. Compound fractures of the acromion process, due to machete wounds, have been more frequently noted. It is asserted that the corocoid process may be



PLATE 1—Incomplete Fracture of Surgical Neck of Right Scapula

broken off as the result of muscular effort, as well as by direct violence, but the author has never seen such a case.

Case Report. — C. M., (No. 22,789) a well-muscled native man, entered the hospital on May 13, 1927, complaining of pain in the right shoulder and arm. He stated that he had fallen from an upper bunk to the floor (about 5 feet), striking on the tip of his right shoulder.

Examination. — No deformity was visible. There was very little limitation of movement, although all movements of the arm or shoulder were painful. The right scapular region and the shoulder were very tender. No crepitus could be elicited. X-ray (See Plate 1, page 148) showed an incomplete fracture of the surgical neck of the right scapula, with some displacement and probable impaction.

Treatment. — The right arm was put up in a modified Jones' position, and strapped firmly to the side. During the 4th week passive motion was commenced, and from the 5th week until the patient's discharge from the hospital on June 22, 1927, full, active movements were permitted. Upon his discharge, there was no pain, tenderness, nor limitation of movement.

COMMENT

It is believed that the line of this fracture was located at the superior median border of the subscapular fossa. It is probable that the long head of the triceps was fully attached to the upper fragment, but fibers of the teres minor must have been torn. No movement of the fragments was obtained with moderate manipulation. During convalescence, at the beginning of the 3rd week of confinement in the hospital, the patient developed pneumonia. Recovery was otherwise uneventful.

LYMPHOBLASTOMA—WITH CASE REPORT

W. A. HUTCHINSON, M. D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

Preliminary Remarks. — Lymphoblastoma, or more commonly lymphosarcoma, is a tumor of mesenchymal origin, the stroma of which is furnished by the tissues invaded. It may be a tumor of greater or lesser density, depending on its character and the rate of growth, and also on the degree of the reaction on the part of the fibroblasts involved. Most authorities agree that the pharynx is a common site of the primary tumor, and that extension to the base of the skull may be prompt. Metastases may involve any part of the body. This class of tumor is not commonly encountered in our practice in Central America.

CASE REPORT

M. S., a colored male, aged 30 years, was admitted to the hospital on March 26, 1927, complaining of pain in the right side of the head, which had persisted for 3 weeks, and which was accompanied by numbness and swelling of the upper lip,

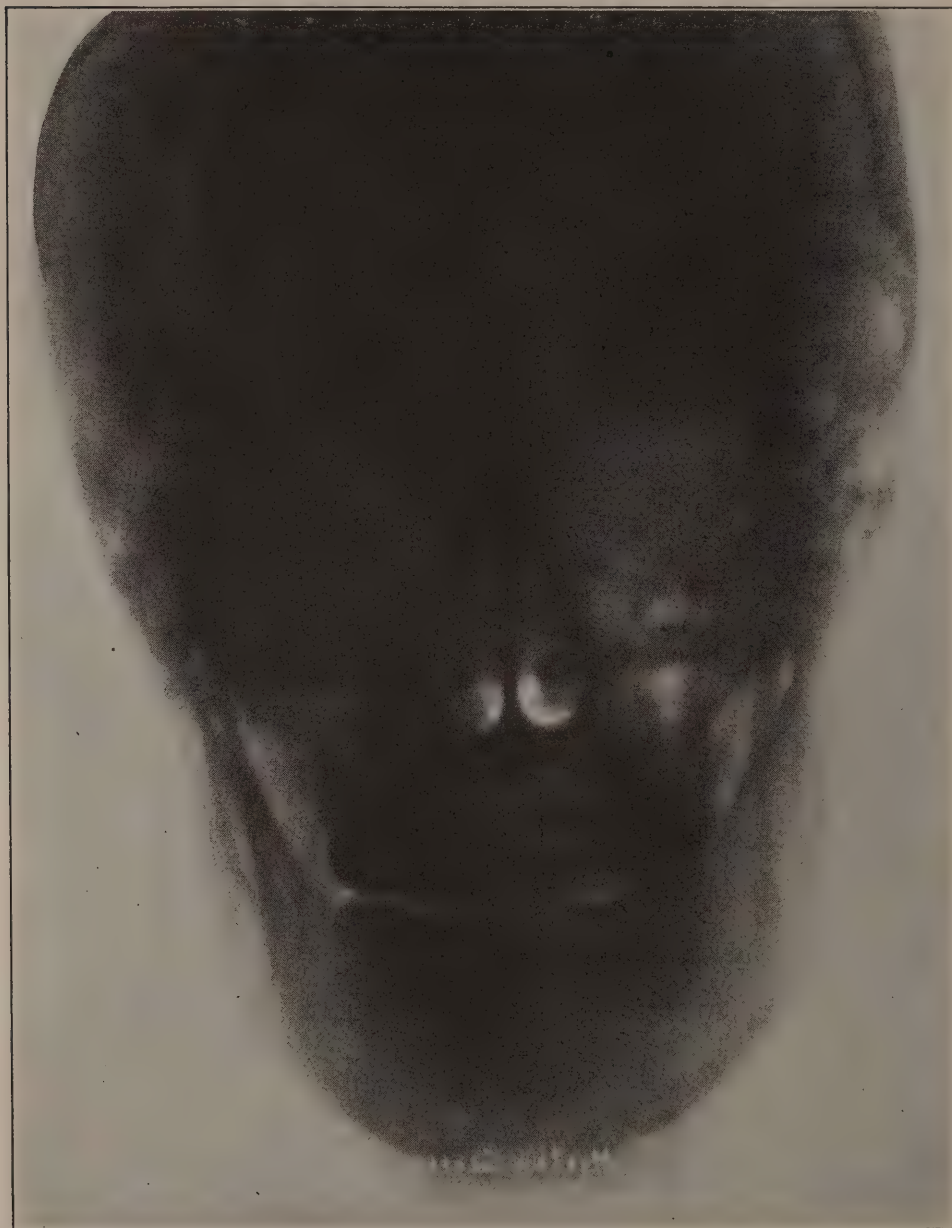


FIG. 1—Skiagraph showing Tumor Shadow in Right Maxillary Region

and inability to breathe through the right nostril. More recently he had noted a throbbing pain in the right temple, and observed that the right eye was becoming more prominent; and, furthermore, that he had developed double vision.

Examination. — This showed a well-developed and well-nourished negro. Exophthalmos of the right eye was noticeable. There was tenderness over the right maxillary sinus on percussion; the turbinates were enlarged; and a small polypoid growth hung from the roof of the right nostril, completely blocking the passage. The pupils were regular, equal, and active; and the eye grounds were negative. There was diplopia,—the inguinal, and the epitrochlear glands were enlarged. Skiagraphs taken on March 26 and April 4 showed a shadow in the right maxillary sinus (See Plate 1, page 150).

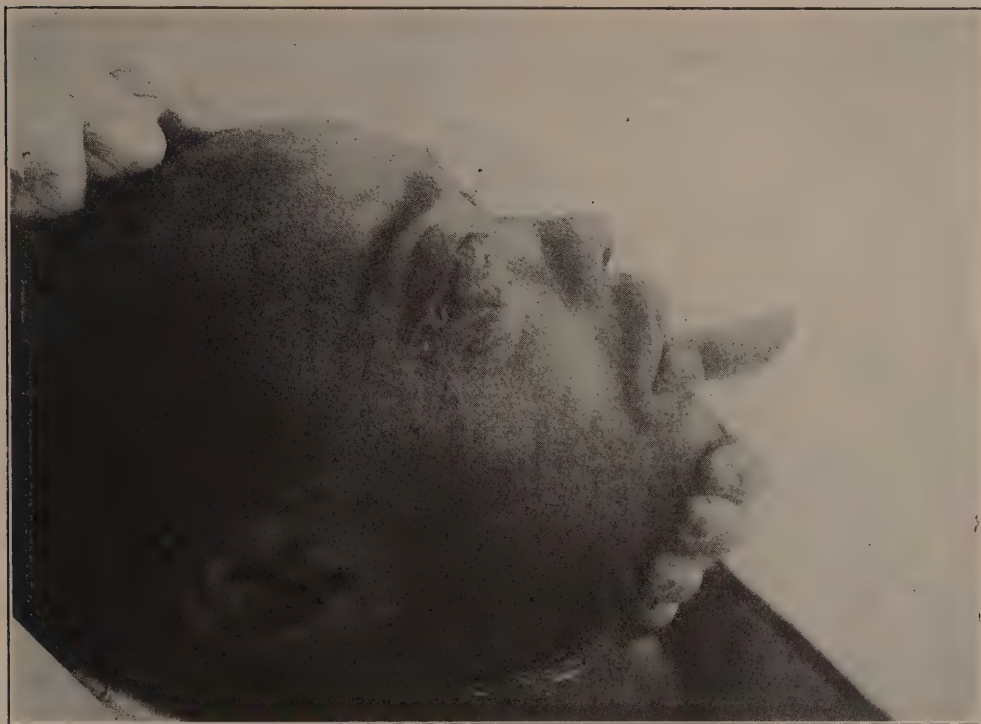


FIG. 2—Showing Appearance of the Tumor at Death

Treatment. — On March 26, an opening was made from the nose into the right maxillary sinus, and irrigation gave negative results. From the date of the sinus puncture there was no further diplopia. On April 4 the patient was discharged from the hospital, having been told that he had a rapidly-growing retrobulbar tumor for which there was no effective treatment.

The patient was readmitted on April 13, complaining of failing vision in the right eye. Exophthalmos was slightly more marked than on the previous admission. On April 15, a small piece of retrobulbar tissue was excised for diagnosis. This was reported on, by Dr. F. B. Mallory, (U. F. S. 117), as follows: "*Microscopic examination of sections from tissue both fixed in A. F. and Z. shows nothing but fat and fibrous tissue with a few very small foci of inflammatory exudation. Diagnosis: Chronic inflammation of fat tissue.*"

The progress of the disease was very rapid.

4/18/27. — Lower right conjunctival sac was bulging, red, and very vascular.

4/24/27. — Eye showed a slight increase in exophthalmos; small swelling on hard palate (see Plate 2, page 151).

4/30/27. — Marked weakness of right leg; patient mildly delirious, and unable to concentrate.

5/2/27. — Unable to stand, and delirious almost constantly.

5/5/27. — Suddenly became violent; and refused to eat or to have any one handle him.

5/6/27. — Condition became rapidly worse.

5/7/27. — The patient died.

AUTOPSY ¹

General Autopsy Findings. — The body was well-developed and well-nourished. The region of the right eye was prominent. There was a small, fresh scar from the incision on the lateral portion of the face, near the outer canthus.

Head. — The region of the sella turcica and tuberculum sellae was enlarged, and the roots of the great and small wings of the right sphenoid were prominent, and filled with white masses of medium consistency. These masses penetrated the bones of this region and extended to the soft palate, into the ethmoid and right maxillary bones, where they filled parts of the maxillary sinus. Parts of the pars petrosa of the right temporal bone were also involved. Some parts of the masses filling the sinus were of gelatinous consistency. The temporal pole of the right temporal lobe of the brain showed a slight impression and softening, but elsewhere the brain appeared normal.

Thoracic Cavity. — The heart was of normal size (325 gms.) and did not show gross pathological changes. The lungs had a mottled appearance, showing small foci of broncho-pneumonia. There was no gross evidence of metastases.

Abdominal Cavity. — The spleen weighed 250 gms. and was rather firm in consistency. Smears from it were negative. The kidneys (270 gms.) showed some white, peanut-size areas, but elsewhere they appeared normal. The liver weighed 1,450 gms. Suprarenals, pancreas, and intestines appeared normal. The intestines contained many ascaris worms. Smears from bone marrow showed pigment, which was probably of malarial origin.

Post-mortem Diagnosis: (1) Sarcoma of right maxillary, sphenoid, and ethmoid bones. (2) Metastases to kidneys.

MICROSCOPIC EXAMINATION ²

Heart. — Negative. *Lungs.* — Small foci of acute inflammatory exudate (polymorphonuclear leucocytes and fibrin) in air sacs, combined with haemor-

1. Performed by Dr. Walter Jantzen, Truxillo R. R. Company Hospital, Puerto Castilla, Honduras

2. Reported by Dr. F. B. Mallory, Boston City Hospital, Boston, Mass.

rhage in places. *Spleen*. — Small amount of pigment present, probably of malarial origin. Plasma cells in small numbers. *Kidney*. — Cortex infiltrated with numerous cells resembling lymphocytes; mitotic figures numerous. *Seminal Vesicles and Prostate*. — Negative. *Testicles*. — Some of the tubules are completely sclerosed. *Adrenals*. — Negative. *Pancreas*. — Markedly infiltrated with cells resembling lymphocytes; mitotic figures fairly numerous. Atrophy, and disappearance of much of the gland tissue. Collections of eosinophiles in places. *Tonsils*. — Practically negative. *Pharynx*. — Negative. *Maxillary and Ethmoid Bones*. — Along one edge is tumor tissue composed of cells resembling lymphocytes. A few mitotic figures present. *Cerebrum*. — A few small collections of cells suggest invasion by tumor.

Microscopic Diagnoses. — Acute bronchopneumonia. — Lymphoblastoma with metastases to kidney and pancreas.

REPORT ON A CASE OF RADICAL CURE OF MORTON'S DISEASE

(METATARSALGIA)

RICARDO AGUILAR, M.D.

United Fruit Company Hospital

Quirigua, Guatemala

History. — The patient, a white lady, had suffered for over a year with pain in the plantar region of the right foot; most marked while she was walking or dancing. At times it became excessive. She compared it to the pain experienced when one tramps on a very sharp stone. After such exercise as dancing, she was frequently unable to sleep for some hours.

Physical examination. — Nothing unusual was apparent except tenderness under the distal end of the 4th metatarsal bone of the right foot.

Treatment. — All local applications and various medical treatments had failed to give relief, and the patient was advised to undergo an operation for radical cure. Under spinal anaesthesia (stovaine) an incision was made along the course of the 4th metatarsal bone, on the dorsal surface, and the joint was exposed. The tendon was pulled aside and the joint opened. The head of the bone was excised with a Gigli saw, about $\frac{1}{2}$ inch behind the joint. The soft tissues were sutured with chromic gut, and a subcuticular silk suture was used in the skin. The patient was kept in bed for 2 weeks, and discharged on the 18th day.

One month later she reported to this hospital for examination. At this time she was able to walk quite well and without pain. Two months later she reported that she was entirely cured, and could indulge in all her customary exercises without any discomfort. The accompanying X-ray pictures show the foot before (Plate 1) and after (Plate 2) operation.



FIG. 1

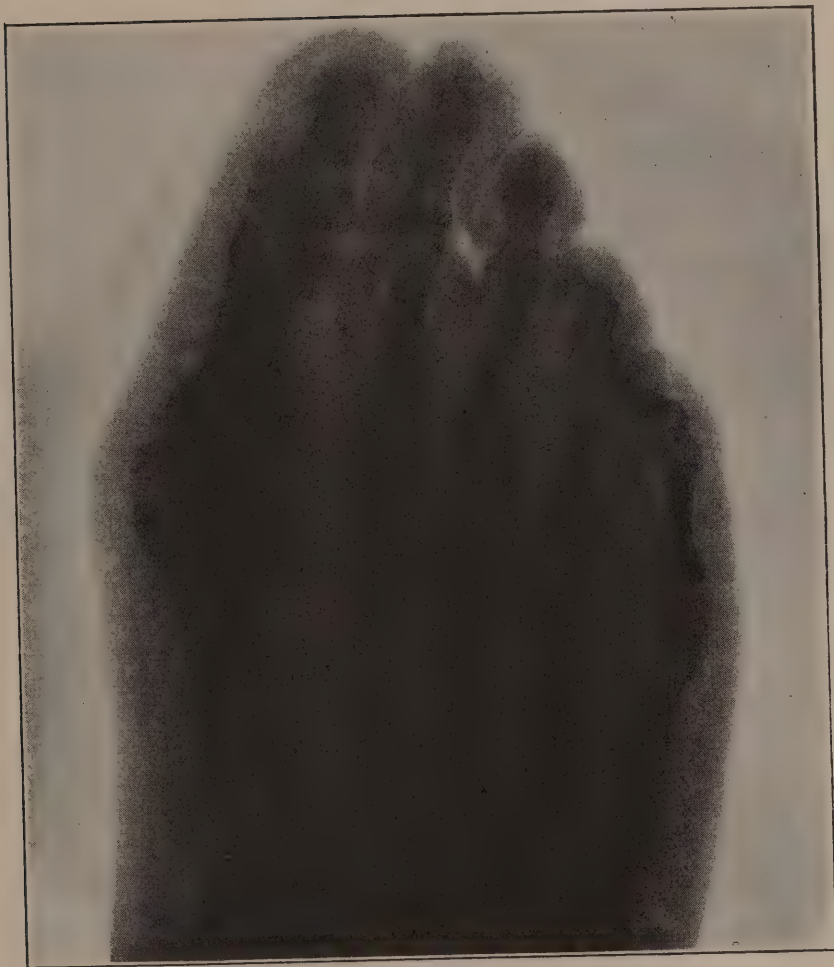


FIG. 2

REVIEW OF MACHETE WOUNDS TREATED DURING 1927

W. A. HUTCHINSON, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

This paper deals with machete wounds of the Central-American laborers that were treated by our hospital surgical service during the year. It reviews the cases to show the extent and gravity of the wounds and the results which followed the treatment of this class of patients. The prevailing opinion of medical men familiar with this kind of practice seems to be that these people have a remarkable resistance to machete wounds and their subsequent infection. This report may serve the desired purpose of adding to the available data on the subject.*

NUMBER AND TYPE OF WOUNDS

We treated 92 cases of machete wounds this year. These cases include solitary, superficial wounds that were $1\frac{1}{2}$ inches or more in length, as well as multiple wounds, some of which were from 6 inches to 12 inches in length, and one case in which there was complete traumatic amputation of the hand.

TABLE I
ANATOMICAL DISTRIBUTION OF SOLITARY MACHETE WOUNDS

Location of Wound	Number of Cases
Head	2 cases
Thorax	4 "
Upper Extremities	
Arm	0 "
Forearm	13 "
Wrist	2 "
Hand	20 "
Digits	7 "
Lower Extremities	
Thigh	3 "
Knee	15 "
Leg	7 "
Foot	9 "
Digits	2 "
Total	84 cases

* See article by Alfred Gage, M.D., "The Machete Versus the Microbe in Central America," *Fifteenth An. Rept., Med. Dept., United Fruit Co., 1926*, p. 205.

TABLE II
ANATOMICAL DISTRIBUTION OF MULTIPLE MACHETE WOUNDS

Series Number	Involved Soft Parts		Involved Bones
1.	Forearms		Fracture of radius and ulna
2.	Scalp (vertex)	3 $\frac{1}{4}$ "	Fracture of skull—both tables Traumatic amputation, hand
3.	Shoulder	3"	
	Forearms (muscles)	3 $\frac{1}{2}$ "	
	Forearms (tendons)	4 $\frac{1}{2}$ "	
4.	Scalp (vertex)	2"	
	Shoulder	4"	Clavicle—outer end
	Shoulder-axilla	8"	Ribs (fracture of ?)
5.	Scalp (occiput)	3"	Fracture of skull—outer table, 2"
	Shoulder	2"	
	Back	3"	
	Palm (tendons)	2"	
6.	Scapular muscles	4"	
	Deltoid muscles	2"	
	Wrist (tendons)	2"	
7.	Scalp (vertex)	3"	
	Hand (tendons)	2 $\frac{1}{2}$ "	
8.	Head-Parietal, flap from vertex of scalp, downward, through external auditory canal to zygoma		Fracture of zygoma
	Scapular muscles	8"	Fracture of clavicle, outer end

TREATMENT

All of the larger wounds with muscle, tendon, or bone involvement were sutured as soon as possible with, in some cases, slight débridement. The wounds in all cases were thoroughly saturated with 2% mercurochrome solution. Splints were applied in cases where the injuries were on the extremities. Daily dressings were done in all infected cases. An important part of the treatment was the institution of early passive motion, followed by active motion as soon as possible, especially in cases of muscle and tendon injury. In this series of 92 cases, only 2 deaths occurred. This gives a mortality rate of 2.17 per cent. Our mortality rate for lobar pneumonia in this same class of patients during the year was 38.18 per cent. One of the deaths due directly to machete wounds resulted from haemorrhage and shock following the fracture of the skull and multiple wounds about the shoulder. The other death was due to extensive brain injury and haemorrhage following a penetrating wound of the cranial cavity caused by the individual's falling on the sharp end of a machete, which entered the head through the orbit.

DISABILITY

In the series there are 4 cases classified as "disabled." One patient suffered permanent disability, owing to the loss of an eye; another lost his left hand; a 3rd has a permanent wrist drop; and a 4th has limited function in one knee.

TABLE III
ASSOCIATED DISEASES FOUND IN THE SERIES
(Occurred Alone or in Some Combination)

Diseases	Number of Cases
Malaria	14
Uncinariasis	58
Ascariasis	10
Leg ulcers	3
Bronchitis	2
Cystitis	1
Syphilis	2
Asthma	1
Cirrhosis of the liver	2
Myocarditis, chronic	1

Purulent infections were present in the wounds of 17 cases before admission to the hospital. The period of time that elapsed between the receipt of these injuries and the admissions to the hospital varied from 15 minutes to 21 days, with an average time of about 2 or 3 days. The primitive home methods of treatment resorted to at the time of the accident or, in some cases, the total lack of any form of treatment before admission to the hospital, no doubt may be held accountable for the extensive purulent infections of some of the wounds. No case of tetanus, however, developed. This disease is almost never noted in machete-wound accidents, although it occasionally occurs in gunshot wounds.

DURATION OF HOSPITAL TREATMENT

The average period of time these cases were under hospital care, was 14 days. Considering the gravity of many of the wounds, and the fact that many of them could not be referred to dispensary services, owing to their homes being far from a dispensary, this is a very brief interval of treatment. It virtually covers the convalescent period, as well as the duration of the illness. In my opinion, it is very remarkable that their recoveries should have been so rapid, and that there should have been so little permanent disability. The majority of the individuals who compose this class of our labor show haemoglobin estimations ranging from 60 to 75 per cent due to malaria, intestinal parasitism, malnutrition, etc.

RECAPITULATION

1. Machete wounds form a significant proportion of our surgical cases.
2. The Central-American labor class has a high resistance to the injuries produced by this form of external violence and the subsequent infections of such wounds.
3. Early, efficient first-aid treatment would materially reduce the hospitalization period for these cases.

PRIMARY CARCINOMA OF THE LIVER IN A YOUNG INDIAN
A CASE REPORT

I. E. PEON, M.D.

United Fruit Company Hospital

Almirante, Panama

History. — R. P., male, aged 31 years, (No. 20,391), laborer, admitted to the hospital on May 10, 1927, had a pain over the liver for four months, with loss of appetite and rapid loss of weight. The patient was a full-blood Panaman Indian, and had lived continuously in the Republic of Panama. He was married; and had three children, all living and well. His usual diet had consisted for the most part, of yucca, yam, plantain, cod fish, and rice. He was in the habit of taking daily one or two drinks of rum, and drank to excess about once a month. *Family history* was unobtainable. He stated that he had had chicken-pox and mumps; one attack of dysentery, six years before; and fever, presumably malaria, on several occasions, though none in recent years. He had left his tribe nine years previously, and had come to Almirante to work for the United Fruit Company.

Physical Examination. — This showed a well-developed but poorly-nourished man. The abdomen was distended with ascites, and there was a distinct prominence over the right upper quadrant and lower right chest. The skin and conjunctiva were markedly jaundiced. Examination of the chest revealed moist râles over the base of the right lung. The breath sounds and tactile fremitus were increased, and there was relative dullness on percussion over this area. The heart sounds seemed weak on auscultation, though the blood pressure was 140 systolic, and 70 diastolic. The heart appeared normal in size and rhythm. The liver was enormously enlarged, extending from the fourth right intercostal space down to two fingers' breadth below the level of the umbilicus. The liver mass was hard and its surface was nodular, with two well-defined protruding masses. The spleen was very much enlarged, extending nearly down to the level of the umbilicus. The surface was smooth, and hard, and the outlines were regular.

Laboratory Findings

Urine. — Large amount of albumin and pus. *Stool.* — *Uncinaria* and *ascaris* ova. *Blood.* — Haemoglobin, 70%; negative for malaria parasites; and negative for syphilis, with the Meinicke test.

Progress of the Case. — The patient's condition became gradually worse, from the date of admission. Vomiting became troublesome; the jaundice was more pronounced; and there was a very rapid loss of weight, due to continuous vomiting of everything taken by mouth. Death ensued on May 26. The autopsy was performed 6 hours after death, and the findings were as follows:—

Autopsy Findings

Primary carcinoma of liver; weight, 4,989 grams. *Splenomegaly;* weight, 1,135 grams. *Ascites;* blood-stained fluid. *Chronic nephritis.* *Ascariasis; uncinariasis.*

Pathological Report. — Specimens of tissue were submitted to Dr. F. B. Mallory, Consulting Pathologist, United Fruit Company, Boston, Mass., who reported as follows:

MICROSCOPICAL EXAMINATION

Liver: Where no tumor tissue is present the liver is much sclerosed, suggesting the type of cirrhosis seen after recovery from acute yellow atrophy. The tumor is epithelial in type with little stroma between the cell masses. In one section the tumor cells are large and well differentiated and more or less closely resemble liver cells. Mitoses occur in small numbers. Dilated bile capillaries are present in places, filled with homogeneous material (inspissated bile?).

Pancreas: Marked post-mortem changes. Several small foci of fat necrosis with slight inflammatory changes about them.

Kidney: Negative.

MICROSCOPIC DIAGNOSIS

Cirrhosis of liver probably following acute yellow atrophy. *Primary liver cell carcinoma.* *Fat necroses in pancreas.*

Comments. — The especially interesting feature of this case is the occurrence of a relatively rare malignant tumor in a young individual whose race is rarely attacked by cancer.

CANCER CASE WITH INTERESTING DIAGNOSTIC COMPLICATIONS

E. W. DAVIS, M.D. AND I. E. PEON, M.D.

Almirante Hospital, Panama

R. P., a colored, male, Jamaican laborer, aged 52 years, was admitted to the hospital April 19, 1927, for treatment of a painless ulcer on the penis, which had persisted for two months and had gradually increased in size.

Clinical Examination. — His physical examination was negative, with the following exceptions:

Mouth: Most of the teeth were missing. Those remaining were carious, with pyorrhoea alveolaris present. *Liver:* Slightly enlarged, and palpable just below the costal border. *Spleen:* Enlarged, and palpable on deep inspiration. *Genitals:* Large ulcer, involving entire glans and corona of penis. The inguinal lymph nodes on both sides were enlarged and hard. The ulceration was apparently a mixed chancre and chancroid.

Laboratory Examination. — On the day of admission a smear was made from the ulcer, and a dark-field examination revealed the presence of *Treponema pallida*. Other laboratory findings were:

Meinicke Reaction for syphilis: + + +; *Blood:* Negative for malaria; *Haemobolin:* 60%; *Urine:* Faint trace of albumin, and granular casts; *Stools:* Negative.

Treatment. — As a result of the positive laboratory findings for syphilis on April 19, active anti-luetic treatment was instituted, with weekly injections of neosalvarsan and protoiodide of mercury pills by mouth, supplemented with increasing doses of potassium iodide. This treatment was continued until May 18, with no apparent improvement in the patient's condition. He was then given injections of bismuth at 3-day intervals, in addition to the other treatment, which was continued until June 20.

Operation. — As there had been no noticeable improvement, a clinical diagnosis of cancer was made and the following radical operation was decided upon: An elliptical incision was made parallel to the inguinal ligaments, from one anterior iliac spine to the other. The lymph nodes and subcutaneous tissues were cleaned out thoroughly from above, downward to the inguinal ligaments; and then from below, upward to the inguinal ligaments. Everything was removed "en masse." The penis was then amputated by the Curtis method, leaving about $2\frac{1}{2}$ inches of the urethra which was transplanted in the midline of the scrotum.

Post-operative progress was uneventful, and with the exception of a slight infection in the upper angle of the wound, which required the removal of one stitch, healing progressed rapidly.

Tissue specimens of the lesion and lymph nodes were sent, for microscopic examination, to Dr. F. B. Mallory, of Boston, who reported as follows:

Microscopic Examination: Shows an epithelial tumor growing moderately rapidly, and complicated on the surface by necrosis and marked inflammatory reaction. Many of the tumor cells are enlarged and undergoing cornification. Epithelial pearls are abundant. In places, the cornified cells are surrounded by foreign-body giant cells. The lymph node sent with the penis is extensively invaded by the tumor.

Microscopic Diagnosis: Epidermoid cancer of penis with metastasis to lymph node.

This case is reported because of the confusion resulting from the positive laboratory findings in the blood and smears from the lesion. Based on these reports, the condition was considered to be a mixed chancre and chancroid lesion, and as a consequence the operation was delayed for several weeks.

DERMAL LEISHMANIASIS—CASE REPORT

O. T. BROSIUS, M.D., F.A.C.P.

United Fruit Company Hospital

Almirante, Panama

Mr. J. appeared at the out-patient clinic with an indurated "sore," approximately the size of a dime, on the outer aspect of the right arm, about half-way between the elbow joint and the shoulder. The patient was 42 years of age, a white American mechanic. He was in good health in every way except for the sore just described.

History of Present Illness. — About 3 months before applying for treatment in our dispensary clinic, the patient was temporarily detailed for duty in Bocas del Toro—the native seaport town distant about 14 miles from Almirante. He claimed that he lived there in clean and healthful surroundings. He was stationed in Bocas for about 3 weeks, then returned to Almirante, and about a week after his return he noticed a small, reddish "pimple" appearing in the location described previously. He squeezed it, and a serous fluid exuded. At this time he went to the States on a leave of absence, and spent his entire vacation (6 weeks) in Mississippi. The lesion grew very gradually, but he did not apply for medical advice until his return to Almirante, which was 2 months, in all, after the appearance of the lesion.

Past Illnesses. — In childhood he had had measles and pneumonia; and in adult life he had two attacks of malaria, and also had had uncinariasis.

Family History. — Negative. The patient was married and the father of one healthy, normal child.

Physical Examination. — He was a large powerful man, and extremely well-developed and well-nourished. He had several bad teeth; but the clinical examination, as well as the laboratory examination of blood, urine and stool, was otherwise negative. Scrapings from the lesion, made by Mr. M. E. Smith, the hospital Laboratory Technician, showed definite Leishman-Donovan bodies.

Lesion. — The lesion increased slightly in size during the week he was under observation. It was crusted and indurated, and on a slight irritation a serous fluid exuded from it. A thin, red, inflammatory ring surrounded the lesion which, at the time of first treatment was a little larger than a dime. At the time the treatment was begun another papule had appeared, about $\frac{1}{2}$ inch from the first sore.

Treatment. — The patient was admitted to the hospital and treated with intravenous injections of a 1% solution of tartar emetic, which was administered as follows: On the 1st day, 3 cc.; 3rd day, 4 cc.; 5th day, 5 cc.; 7th day, 6 cc. There were no untoward effects from the medication until the 6 cc. dose was given,

when the patient was seized with a spasmodic cough so severe that he became cyanosed and could scarcely breathe. These symptoms, however, quickly subsided and the patient felt no ill effects thereafter. No further treatments were given. The small papule had disappeared by the 5th day, and the larger lesion had completely healed by the 10th day. While in the active state, the lesion appeared exactly like a vaccination "take," and after the cure was effected it resembled a vaccination scar.

This case is reported because of its quick response under an unusually small dosage of tartar emetic, and because the disease is comparatively rare in Caucasians, in the western hemisphere.

A CASE OF FACIAL ACTINOMYCOSIS*

JAIME DE LA GUARDIA, M.D.

Preston Hospital, Cuba

Case. — A. H., Cuban, white, female, aged 20 years.

Past History.— Negative. *Present History.* — Five months previous to admission she suffered from a slight pain over right maxillary region, which gradually became worse. She consulted a physician, who attributed her trouble to dental caries and a poorly fitting dental bridge. She was referred to a dentist, who extracted the teeth and removed the bridge. A slight improvement followed, but 2 months later a decided swelling appeared in the same region, which, increasing gradually, involved the temporal, zygomatic, and supra-orbital areas. She consulted several other physicians, who prescribed for her ointments and other external applications; no apparent improvement followed their use. She entered this Hospital on March 18, 1927.

Physical Examination. — A well-developed, well-nourished young adult female. General physical examination was negative. Meinicke test, negative.

Face. — A hard, board-like nodular swelling, purplish in color, involving the temporal, maxillary, and zygomatic regions was seen. It showed an area of softening, in the center of which was an unhealthy granulomatous ulcer—the opening of a fistulous tract.

Diagnosis. — The negative blood-test for syphilis and the good general appearance of the patient ruled out the diagnosis of a syphilitic gumma or tuberculoma. The radiograms showed no bone involvement, and excluded our tentative diagnosis of sarcoma. Actinomycosis was then considered. Examination of the purulent discharge from the fistula showed the typical "sulphur grain" bodies, which microscopically proved to consist of a network of threads with club-shaped extremities, the ray fungi, characteristic of this disease. This diagnosis was con-

* Reported before the 8th Congreso Médico Nacional Cubano



FIG. 1—Before Treatment



FIG. 2—Location of Lesion

firmed by pathological examination of excised tissue by Dr. Mallory (UFS 112). A. H.

Treatment.

Local. — Excision and curettage of fistula and granulomatous tissues, and cauterization of the area with pure carbolic acid. This was followed by daily



FIG. 3—After Treatment

dressings with 50% Lugol's solution. *General.* — Six intravenous injections of sodium iodide (2 gms. each) were given, 1 every 4th day, followed by the oral administration of 1 gm. of potassium iodide t.i.d., until slight gastric symptoms appeared. It was then discontinued for a week and 1 gm. of sodium iodide t.i.d. was given again until June 20, 1927 (date when last picture was taken.) The excellent result can be seen by comparing pictures taken before and after the treatment. Up to the present time (a year later) there is no sign of recurrence.

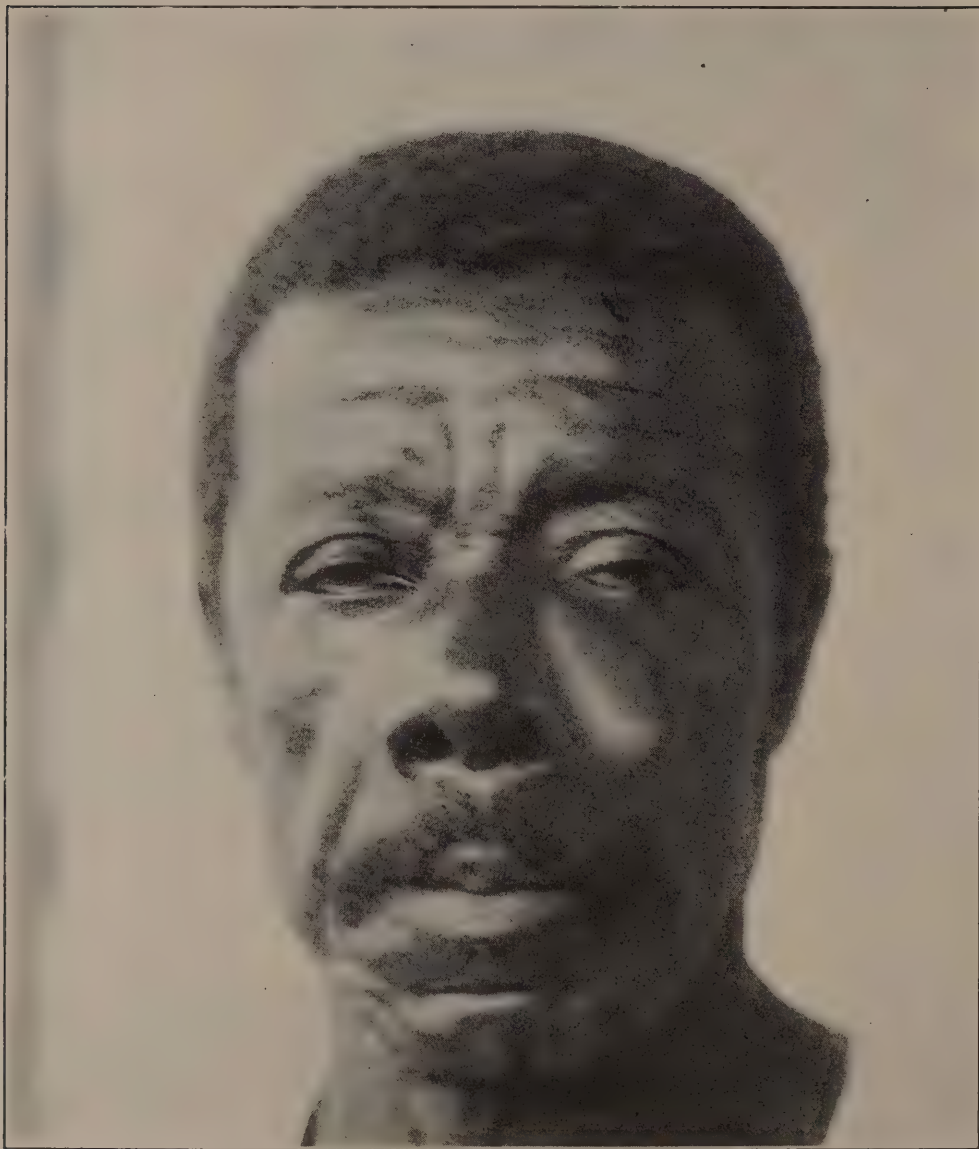
REPORT OF A CASE DIAGNOSED AS GOUNDOU

R. L. CARROLL, M.D.

Almirante Hospital, Panama

The patient, a male Jamaican negro laborer, aged 46 years, came to Panama 20 years ago from Jamaica, and has always lived in either Panama or Jamaica. He was admitted to the hospital with retention of urine, because of prostatic hypertrophy. Routine physical examination revealed the following unusual condition:

On the left side of the nose, beginning at the middle and extending outward and downward (see Photograph 1) there is a mass about 3.5 cm. long and 2.5 cm. wide, involving the nasal process of the left superior maxilla. The mass is smooth, hard, firmly fixed, and has the appearance of a bony tumor. The overlying skin appears normal and is freely movable. The tumor mass impinges upon, and almost occludes, the upper part of the left nasal cavity. The middle and inferior turbinates are pushed inward, lying almost in contact with the nasal



PHOTOGRAPH 1

septum. There are no pathological changes noted in other bones of the body. The general health is good, except for the condition for which he was admitted to the hospital. The patient states that he has seen this condition 3 times in Jamaica, but not in any member of his family.

A history of injury was given as follows:

About 4 years ago he was struck on the left side of the nose by a piece of wood, which caused a slight laceration, with some pain and swelling at the time of the accident. The wound healed in about 3 days, and there has been no pain or discomfort at the site of the wound since the time of injury. For some time prior to the injury there was a more or less constant nasal discharge, which continued for about 3 months after the accident.

The patient attributes the nasal swelling to the accident, although there was nasal discharge prior thereto. It seems probable that the injury was a coincidence.

The blood was positive for syphilis (Meinicke's test) and he was given 6 doses of neosalvarsan 0.6 grm. each, and iodide of potash in increasing doses was administered for 1 month prior to his discharge from the hospital, without any noticeable change in the size or consistency of the tumor.

As the lesion had given no trouble since the initial stage, he refused operation for the removal of excess bone; hence, no tissue was available for microscopic study.

Clinically the condition agrees with the diagnosis of Goundou, as described in the literature, although Byam and Archibald* say, "The possibility of infection (if it be an infection) is not credited after the 20th year."

SYPHILIS—REPORT OF AN UNUSUAL CASE

O. T. BROSIUS, M.D., F.A.C.P.

United Fruit Company Hospital

Almirante, Panama

Because this case was so extremely resistant to all anti-luetic treatments, it has been considered of sufficient interest to warrant submitting an addendum to the detailed account given in the 1926 Annual Report.¹ Since then there has been a serious exacerbation, and much more treatment has had to be administered.

In January, 1927, the Meinicke test was still +, whereupon 12 injections each of mercury salicylate, flumerin, and bismuth were given in that order, alternately, 5 days apart. During this course of treatment, the Meinicke test was again ++ in February and in April, and + in June. After the course of injections was completed, potassium iodide was once more used and continued

* "The Practice of Medicine in the Tropics."

1. See Case No. 1, Annual Report, Medical Department, United Fruit Company, p. 150.

to the limit of tolerance. The Meinicke test in July, at the completion of the series of injections and at the beginning of the course of potassium iodide, was negative.

Right Eye Again Affected. — Suddenly, in September, the right eye (the one which had been operated) again flared up with an acute inflammatory process, and the patient was immediately sent again to Dr. Reeder, who resumed anti-luetic therapy, in addition to local application.

During the succeeding 3 months, 5 injections of sulpharsphenamine, 6 of mercury salicylate, and 24 of bismuth, were administered. Clinically the patient appeared to have completely recovered, and the Meinicke test was again negative in November. The course of medication described in this paragraph was completed January 1, 1928. At the time of writing (January 6, 1928) the patient seems entirely cured, but the Meinicke test was still reported + positive yesterday, January 5, 1928.

Summary. — The establishment of a permanent cure is still doubtful, although, in all, the patient has had the following medication over a period of 3 years and 9 months: 29 injections of neosalvarsan, 19 of which were of full dosage of 0.9 gr. each; 8 of 0.75 gr. each; 1 of .6 gr.; and 1 of .45 gr. In addition, the following numbers of injections of other drugs were given: sulpharsphenamine 5; metaphen and salvarsan combined 2; flumerin 24; bismuth 48; and mercury salicylate 22. Besides these injections, mercury and potassium iodide were both administered over 3 different periods—each time to the limit of tolerance.

LICHEN SPINULOSUS, A MANIFESTATION OF LATE FRAMBOESIA

WILHELM CORDES, M.D.

United Fruit Company Hospital
Preston, Cuba

Lichen spinulosus seu pilaris is described, in Stelwagon's "Treatise on Diseases of the Skin," as a hypertrophic skin affection, characterized by the formation of pinhead-sized, conical epidermic elevations situated about the apertures of the hair follicles. The papules contain, in the center, a horny spine which can be picked out, leaving a depression. These papules are densely crowded into patches, often large and irregular in outline, and symmetrically distributed. The favorite sites are the back of the neck, the buttocks, over the trochanters, the abdomen, the back of the thighs, the popliteal spaces, and the extensor surfaces of the arms.

Lichen spinulosus seems practically identical with the condition known to dermatologists as *Keratosis pilaris*. This disease, as seen in temperate zones, is

of obscure etiology. Seasonal and hereditary influences are suspected. It is regarded as forming a pathological part of general ichthyosis.

Baermann and Castellani, as well as Kurita (cited in Mense's "Handbuch der Tropenkrankheiten") drew attention to the fact that *Lichen spinulosus* is often associated with tropical framboesia, of which it is possibly a late skin manifestation.



Lichen Spinulosus, a Late Manifestation

Observations made in Preston Hospital during the year just past, suggest this causative relation. Among 110 patients who showed symptoms or gave a history of framboesia, fully-developed and extensive *Lichen spinulosus* was seen in 2 cases. They were male, colored Haitians, aged 25 and 55 years, who had contracted framboesia during childhood. Scars of primary or secondary lesions and enlarged glands were present, and the Meinicke test was strongly positive in both cases. The skin conditions corresponded in appearance and localization with the description given above. The patches were slightly elevated and more reddish in color than the surrounding skin, which betrayed their subacutely inflammatory character. The patients complained also of itching, which, although not severe, was annoying enough to call for medical aid. After treatment with neosalvarsan and bismuth, the subjective symptoms subsided and the color of the patches became normal. The horny papules, however, persisted during the 3 to 4 weeks of their hospital stay.

In one case, which is shown in the illustration, page 169, a piece of skin was excised for pathological examination. The report, by Dr. F. B. Mallory, of Boston, was as follows:

There is slight papillary outgrowth of the corium with lymphocytic infiltration around the blood-vessels,—also marked hyperkeratosis at the mouths of the hair follicles. Microscopical diagnosis: Simple papilloma with chronic inflammation.

It would be difficult, if not impossible, in these 2 cases to incriminate the *Treponema pertenue* as the definite etiological factor, but it seems possible from clinical observations that it may be at least a contributory factor.

SEVERE POST-PARTUM ECLAMPSIA

Treated by Intravenous Injections of
3% Sodium Bicarbonate Solution

N. P. MACPHAIL, M.D.

United Fruit Company Hospital
Quirigua, Guatemala

CASE REPORT

The patient, a primipara, aged 34 years, a robust, white woman, came under observation in the early months of pregnancy. Up to the 6th month, a specimen of urine was examined monthly; then weekly until her admission to the hospital. All specimens were negative throughout the term.

At the end of the 7th month the usual examination revealed nothing of special interest, except that the fetus was unusually small. The confinement was due on the 15th of March.

On March 4 the patient presented herself for consultation and stated that she had been "involuntarily passing small quantities of water all forenoon." She was placed in bed, under observation, and it was evident that the membranes had ruptured. The urine was negative, on admission.

On March 9 she had slight uterine contractions.

A morning specimen of urine on March 10 showed albumin, with hyaline and granular casts. This was confirmed later by examination of a catheterized specimen. The patient was placed on water only, and later in the day she went into labor. At this stage she had no headache, the pulse rate ranged from 90 to 100, and no symptoms of serious trouble appeared. At 11.50 P.M. on the same day she was delivered of a female child which weighed 3 pounds.

For the next 2 days she was given large quantities of water by mouth; and 1 dram of sodium bicarbonate, dissolved in water, was administered every 4 hours. Twenty-eight ounces of urine were excreted the day after confinement, and 32 ounces on the following day. Small amounts of milk were allowed on the 3rd day; and the bowels moved freely. On the 4th day 66 ounces of urine were excreted during the 24 hours, and all specimens contained large quantities of albumin, pus, and casts.

On the 5th morning after delivery, at 6 A.M., the patient had a very violent convulsion, which lasted over 3 minutes. During the convulsion she bit her tongue, her face was contorted and livid, and opisthotonos was very marked. The pupils were markedly dilated, and the patient remained unconscious for approximately one-half hour after the convulsion had ceased. When she became conscious she complained of severe headache, dimness of vision, hemianopsia, and severe pains in the muscles of the arms and legs. A brisk saline purge, and water by mouth, were given; and the patient was kept extremely quiet. At 9 A.M. she had another severe convulsion, more violent, and lasting longer than the first, and she remained comatose for approximately one hour. At 12 noon the patient had another convulsion, of terrific violence, in which all the symptoms present in previous attacks were still more marked. Blood-stained froth came from the mouth; the eyes protruded; and cyanosis was very pronounced. Breathing stopped completely for an appreciable period, and the patient seemed to be dying, as the pulse became barely perceptible.

When she recovered from the convulsion, she remained in coma for approximately 3 hours. All the usual routine care and treatment had been carefully attended to; but the prognosis seemed very doubtful, and it was decided to give her sodium bicarbonate intravenously. At 1 P.M. an injection of 250 cc. of a 3% solution was given, and 3 hours later another injection of 350 cc. was administered. While the 2nd injection was being given, the patient struggled and resisted considerably, and began to come out of the coma.

No further convulsions appeared, the pulse became of better quality, consciousness returned, and the symptoms of which she complained gradually disappeared.

The amount of urine voided on the 5th day was 26 ounces, and on the following day she voided 35 ounces. Albumin and casts gradually disappeared, and the urine was reported negative on the 14th day after delivery.

COMMENTS

The points of special interest in this case were, the extremely violent eclamptic convulsions developed on the 5th day after delivery in spite of very rigid preventive measures, the increasing intensity of the succeeding convulsions at 3-hour intervals, and the cessation of convulsions on administration of sodium bicarbonate solution intravenously.

It is not possible to base on the findings in one case a strong statement as to the value of sodium bicarbonate solution administered intravenously in such cases; but, considered along with the cases which have been recently reported in the medical literature, our findings appear to provide an additional argument in favor of using this method of treatment in combating this very serious disease.

The writer was especially encouraged to use this treatment by an article on the subject, by Dr. H. P. Wilson, published in the Feb. 5, 1927 edition of the *Journal of the American Medical Association*.

BERI-BERI-LIKE POLYNEURITIS—CASE REPORTS

WALTER JANTZEN, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

Five cases of polyneuritis were observed by our staff during the past three years, and these are reported herewith. All are of special interest because of the infrequent occurrence of polyneuritis in this particular locality, and these cases are probably the only ones noted medically since the opening of this division nine years ago:—

CASE REPORT No. 1

A. P., Jamaican negro, aged 28 years, was admitted to the hospital on October 5, 1925, because of his inability to walk. He gave a history of having been physically indisposed for eight days previously. He had resided with other laborers on one of the farms and, like the others, his diet had consisted principally of rice, beans, and bananas, with occasional meats.

Physical Examination.—The tongue was coated, and the glands were enlarged generally. The Meinicke turbidity reaction and flocculation test for syphilis were negative. The spinal fluid was negative. The blood examination by the thick-film method showed the presence of some E.A. rings and crescents. Urine, negative.

On the first day he had a temperature of 101° F., which became normal on the following day and remained so until death.

Twenty grains of quinine sulphate were administered twice daily to the patient during his stay at the hospital.

The physical findings showed the patella reflexes to be absent, and also a negative Babinski. Plantar reflexes were present. The skin was anaesthetic over the tibial crests and the dorsa of the feet, especially on the right lower limb. The anal and bladder sphincters functioned normally. There was inability to walk, on account of paralysis affecting both the feet and the leg muscles. The calves of the legs were very painful on pressure. All superficial and deep reflexes disappeared, except the cremaster reflexes. Numbness of the finger tips was noted. On the following day the paralysis ascended; the breathing became labored; and there was less strength in the arm muscles. The heart became dilated, and the pulse very rapid; and death occurred on October 23, 1925.

Autopsy Findings.—These revealed a hydropericardium, and an extremely dilated heart, with very soft muscle. Also, there were small areas of bronchopneumonia in both lungs. The brain, spinal cord, and peripheral nerves were negative microscopically.

CASE REPORT No. 2

M. Z., female, native of Honduras, aged 38 years, was admitted to the hospital on December 10, 1925, because of inability to walk. The disease had begun 3 weeks previously, manifested principally by "pains in all the limbs." Eight days prior to admission the patient developed paraesthesia of the lower limbs, a general weakness, and inability to walk. She had 2 healthy children; 2 had died of unknown causes; and she had had 1 miscarriage. Her diet was similar to that reported in the preceding case.

Physical Examination. — This showed a fairly well-developed and well-nourished native woman, with carious teeth. The chest and abdomen were negative, and the blood showed no malarial parasites. Cranial nerves were normal. The elbow and forearm reflexes were diminished; and the superficial abdominal reflexes, deep reflexes of the lower limbs, and the Babinski's reflex were absent. Strength was diminished in all leg muscles, especially those of the peroneal group. Numbness was present in the finger tips; and there was a marked decrease in the tactile perceptibility and pain-sense of the skin covering the shins and the dorsa of the feet. The woman was totally unable to walk. Bladder and anal sphincters were normal. The Meinicke turbidity test for syphilis in the blood serum was 4+ positive. Spinal fluid was normal.

Developments. — On January 26, 1926, her condition became worse. Paralysis of the muscles supplied by the peroneal nerves was apparent. There was no tactile sense over these areas, and sensation of pain was diminished. She complained of pricking and creeping sensations in both the arms and the legs.

Later, she was removed from the hospital by her relatives, in an unimproved condition. I did not see her again.

CASE REPORT NO. 3

M. M., Honduran male, aged 21 years, entered the hospital on November 18, 1926. He gave a history of having enjoyed good health previously. There was no history of venereal disease. He used alcohol moderately and his diet had consisted mainly of rice, beans, and bananas, with meat occasionally. Two weeks before admission he had become ill, suffering from numbness, paraesthesia, and a weakness in both legs, which rendered him unable to walk.

Physical Examination. — This showed a well-developed and well-nourished native. Organs of the chest and abdomen were normal. Temperature was normal, but the pulse was slightly increased. Cranial nerves were normal. Abdominal, cremasteric, and plantar reflexes were present. The tendon reflexes of the elbows, forearms, patella, and heel, were absent. Tactile perceptibility and pain-sense were decreased in both legs, especially over the tibia and the dorsa of the feet. Thermic sense was normal. Sphincters of anus and bladder were unaffected. The patient complained of paraesthesia in both legs. The strength in the arms and hands was apparently normal, but it was diminished greatly in the legs. Paralysis of the peroneal group of muscles was apparent. The calf muscles showed atrophy, and were painful on pressure. The Meinicke test for syphilis on the blood and spinal fluid was negative. The urine was negative; stool positive for uncinaria ova. The blood was negative for malaria; hemoglobin, 80%; leucocytes, 8,600; and eosinophiles, 12%.

Developments. — On November 29, 1926, his condition grew worse; he complained of creeping and prickling sensations in the arms, and he had difficulty in swallowing. There was slight paresis of the right facial nerve. Marked thoracic respirations, indicating a possible paralysis of the diaphragm, developed. The pulse was 120, and the right side of the heart showed indications of dilatation. The weakness in the legs increased. By December 31, 1926, his general condition had improved very much. The pulse and respiration were normal, and there were no further signs of heart dilatation. The nervous derangement, however, remained unchanged, and all muscles were painful on pressure. One month later he could walk about on crutches, but with difficulty, as the peroneal muscles were still paralyzed. The gait was markedly ataxic, on account of muscle weakness; and the muscles themselves were atrophied and very flabby. The facial-nerve paralysis cleared up, but the other nervous conditions remained as before. On March 19, 1927, he was walking well without crutches, but complained of burning pains in the legs. Tactile

sensation had improved, but was not normal. The patellar reflexes of the legs were still absent. The patient was discharged from the hospital upon his own request, and after that the case could not be followed further.

CASE REPORT No. 4

R. M., male, native of Honduras, aged 54 years, was admitted to the hospital on October 16, 1927, with a history of one month's illness, manifested by a general weakness of the legs and a sensation of numbness in his feet and hands. He had never been seriously ill before; had had no venereal infections; and used alcohol only moderately. His diet had been similar to that of the other cases.

Physical Examination.—This showed a fairly well-developed and well-nourished man; dental caries was present. He walked with difficulty, and his gait was ataxic. Chest and abdomen were negative; blood and urine, negative; Meinicke test for syphilis, negative.

Developments.—Five days after admission to the hospital he complained of numbness of the lips, and had difficulty in expectorating. Spinal-fluid examination showed a normal cell-count and a negative Meinicke test. Up to November 16, 1927, there was no change in his condition, and he still walked with difficulty. An examination of the nervous system at this time revealed partial paralysis of the 7th cranial nerve. Other cranial nerves were normal. The Babinski's, patellar, and tendo Achillis reflexes were absent. The tactile sense and tendon reflexes of the arms were normal; and the abdominal and cremasteric responses were present. The plantar reflexes were present, but there was loss of tactile sense over the skin on the inner sides of the calves and on the dorsa of the feet. The pain-sense, to pin pricks, was diminished and extended up to the inner surface of the thighs. The thermic sense was not appreciably affected, but hyperaesthesia was present on the plantar surface of the left foot. Pressure over the calf muscles did not elicit any pain. The anal and bladder sphincters functioned normally. There was a marked weakness of all leg and foot muscles, which were atrophic and flabby. The gait was ataxic, and walking was impossible without assistance. On December 19, 1927, there was physical improvement, and the patient was able to walk alone. The left patellar reflex responded slightly, but the right remained absent. The right tendo Achillis reflex was present, but the left absent. Tactile and pain sense had returned to some extent, but were not normal. Cranial and arm nerves appeared normal. However, the patient was still unable to rise from a chair or from a prone position without the use of his arms. On December 31 his condition was practically unchanged. He is still under treatment.

CASE REPORT No. 5

J. V., Honduran, male, aged 31 years, was admitted to the hospital on November 23, 1927, with a history of one month's illness, which began with fever that lasted for 6 days and was followed by an increasing weakness and numbness in both legs. For the 8 days preceding his admission to the hospital, he had been unable to walk. He used alcohol moderately, and ate about the same classes of food as did the other cases reported. He had had syphilis 4 years before, and gonorrhoea about 1 year previously, before the present illness developed.

Physical Examination.—This showed a well-developed individual, with sufficient adipose tissue to appear well-nourished. Temperature was normal. Lymphatic glands were enlarged generally. Spleen was palpable 2 fingers below costal margin. Head and chest organs were normal. Small patches resembling psoriasis were found on the auriculae of the ears and in the region of the olecranon. Blood examinations showed his haemoglobin to be 80%. A

thick film was positive for E.A. malarial parasites. The Meinicke test for syphilis was 4+. Urine was negative. The cranial nerves and the arm reflexes appeared normal. Abdominal, cremasteric and Babinski's reflexes and deep reflexes of lower extremities were absent. Arm muscles were normal. There was feebleness of the leg muscles, which were atrophic and flabby; and the feet were almost completely paralyzed. He had severe pain, upon pressure, over the calf muscles. Tactile sense was absent in the legs and feet, and no sensation to pin-prick was present on the anterior surfaces of the thighs and below the knees. Thermic and muscular sense was present; and bladder and other sphincters were normal. The patient was unable to rise from a prone position.

Developments. — On December 5 he complained of weakness, and numbness of the hands and lips. Strength in arms and legs decreased. Pain and tactile sense in the right hand was diminished, and marked paresis of both facial nerves had developed. He mentioned his inability to control the lower jaw while eating. On December 19 his condition was unchanged. Numbness of lips, hands, and thighs persisted. All deep reflexes were absent. Cremasteric, Babinski's, and plantar reflexes were absent. Abdominal reflex was slightly positive. There was a slight tactile disturbance in the tip of the fingers supplied by the median nerve. The lower extremities showed practically no tactile or pain sense reactions, and over the anterior surface of both thighs it was retarded. Mobility was about the same as before, and the patient walked with the aid of a cane. On December 31 he showed a slight improvement, but still remained at the hospital.

COMMENTS

Similarity of Symptoms. — The general symptoms manifested in each of these cases showed a marked similarity. All entered the hospital complaining of paraesthesia and increasing weakness in the legs. Some patients were unable to walk at all, and others gave a history of impaired locomotion for varying periods of time prior to admission.

The clinical examinations revealed, in each case, the symptoms of a multiple neuritis involving the lower extremities particularly; and the superficial and deep reflexes of all cases were either partly or totally lost. Sensation generally was more or less altered. The muscles of the bladder, anus, and abdomen functioned normally. In only 2 cases were the heart and respiration affected. The spinal fluid in each instance was negative; and even in the 1 fatal case there were no macroscopic findings of disease in the brain and spinal cord. Two patients exhibited a disturbance in the upper limbs, and in these the 5th and 7th nerves were involved. Also, in 2 cases the vagus and phrenic nerves were affected. The muscles enervated by disordered nerves were atrophic and flabby; and evidenced, more or less, a loss of function. The calf muscles were painful on pressure. When walking was possible at all, the gait was ataxic, owing to muscular weakness or paralysis of the peroneal groups of muscles. When examined, all patients were unable to rise from a sitting or a prone position without the help of their arms.

Heart Effects. — In 2 cases, the heart showed dilatation, and its action was accelerated. Blood tests for syphilis and malarial parasites were positive in 2 cases. The 1 fatal case died of heart failure within a few days, following a rapid

progress of the nerve involvement. Autopsy findings showed a dilated heart and a hydropericardium. Macroscopically, the other organs and the nervous system seemed normal. There were no definite signs of alcohol, arsenic or lead poisoning in any of our cases; nor did their symptoms appear to coincide with those of the aforementioned poisons.

Discussion of Diagnosis. — The clinical symptoms of all were fairly typical of the paralytic form of beri-beri; but there are many objections to that diagnosis, some of which are mentioned herewith:

The cases came from various farms situated many kilometers distant from one another; and the diet of these patients did not seem to differ from that of the farm laborers in general, which consists mainly of rice, beans, and bananas, and meat occasionally.

As beans and bananas are rich in Vitamin B, the food-deficiency theory does not offer a satisfactory explanation in these cases. Many laborers live together under the same conditions and, therefore, we should encounter the disease more frequently if it were the result of a diet deficiency or any special method of preparing the food.

Also, if an infection had been the underlying cause it would seem that more persons would have been affected by it. I might add that we saw no patients with the oedematous form of beri-beri.

Finally, it is quite possible that we were dealing with a multiple neuritis which is classified as an acute febrile polyneuritis, a primary affection, and believed by certain medical observers in the past to be due to a virus as yet unknown. Cases of this acute febrile type occurred with considerable frequency during the World War. In one type the paralysis was preceded by an initial attack of fever of brief duration; and in the other, paralysis was the first symptom. In the former type an interval of from 5 to 10 days elapsed between the initial illness and the onset of the paralysis. The cortex is spared; and the virus appears to expend its virulence upon the spinal ganglia, the cord, and the peripheral nerves. Following upon the temperature, a typical neuritis symptom-complex develops, taking the form of an ascending paralysis of varying degrees. In the milder forms recovery is the rule, generally within a few weeks; and residual paralyses are common, but not lasting. Death is reported as common in the severe forms.

LIVER AND SPECIAL DIET IN THE TREATMENT OF ANAEMIAS

A. A. FACTO, M.D., F.A.C.S.

United Fruit Company Hospital

Limon, Costa Rica

The object of this paper is to report the results obtained in the treatment of pernicious anaemia and similar conditions with a properly balanced diet of which beef's or calf's liver is the principal constituent of the menu.

Until it was casually discovered that liver, taken as a food, reacted in the hematopoietic organs in such a manner as to induce the reproduction of blood cells, after this process had ceased, as the result of disease, to function normally, the treatment of pernicious anaemia and allied conditions was, with the exception of rest and hygienic measures, essentially medicinal. Arsenic and iron, because of their blood-building properties, were usually the chosen agents. Other measures, such as splenectomy, the application of the X-ray, and transfusion of blood, have been practiced; but, in general, any improvement obtained in the blood condition was, with very few exceptions, only transitory.

During the year 1927 we have had under our care several cases of anaemias, of different types, all of which have responded miraculously to the liver treatment in combination with a properly balanced diet and the usual routine measures.

A CASE REPORT

The following case, the first to be treated in this manner by us in accordance with the advice of Dr. W. E. Deeks, who had been consulted, may be taken as representative of the results obtained with the average patient receiving this method of treatment under our supervision. It may well serve to illustrate our conclusions.

History. — D. G. C., male, aged 46 years, has lived all his life in the Tropics and sub-Tropics. He is a merchant by trade and his dietary habits have been most irregular; he has taken his meals at any time, partaking immoderately of carbohydrates and artificially sweetened foods, and eating scarcely any fresh fruits or vegetables. His illness dates from some three years ago, and began with the more or less typical symptoms of sprue, sore mouth, dyspepsia, and frothy diarrhoea. At the beginning, these symptoms occurred sporadically, with intervals of apparently good health; but more recently they gradually became more pronounced. The patient had consulted several doctors. His case was diagnosed as sprue, and he had been treated interruptedly for that disease.

The soreness in the mouth disappeared altogether about a year ago, and the last attack of diarrhoea occurred in November, 1926; but the dyspeptic symptoms have been more or less persistent. He had grown progressively weaker; to such an extent that he was forced to take to his bed six weeks ago, feeling very much worried about his condition.

Physical Examination. — Although not markedly emaciated, the body tissues were flabby. The patient had a brownish-green, muddy complexion; and the lips, gums, and tongue seemed bloodless. He felt very weak, and at times irritable, with rather frequent dyspeptic distension of the abdomen, and anorexia. The bowels had been moving but once a day, toward noon; the evacuation period was quite prolonged, and left him in a very exhausted condition. The dejecta were very copious, black, pasty, fermenting, mawkish, and terribly offensive. The heart palpitated with the least emotion, and the slightest exertion caused shortness of breath. The pulse was soft, and a haemic murmur was present.

First Blood Examination (March 26, 1927). — Haemoglobin, 60%; erythrocytes, 1,800,000; color index, 1.06; achromatosis, poikilocytosis, and granular basophilic degeneration present; leucocytes, 10,000. *Differential Count.* — Polynuclears, 68%; polybasophiles, 1%; eosinophiles, 3%; small lymphocytes, 18%; large lymphocytes, 4%; large mononuclears, 0%; transitional forms, 6%. Malaria, negative; faeces, negative for intestinal parasites; cultures of

the faeces negative. The urine was highly colored, of low specific gravity (1.008), and had traces of indican.

Treatment. — This was principally directed, as suggested by Dr. W. E. Deeks, toward a correction of the patient's eating habits and the administration, daily, of half a pound of not overcooked beef's or calf's liver. Plenty of green vegetables and fresh fruit was given, notwithstanding the gastro-intestinal symptoms; and the carbohydrates were restricted to those of root origin, chiefly, such as potatoes, beets, carrots, and onions. The cereal-derived carbohydrates, as well as sugar and the artificially-sweetened foods, were absolutely prohibited.

As a tonic, one subcutaneous injection of cacodylate of soda, of 0.50 gm., was given daily for 12 days, followed by an interval of 7 days, after which 12 more injections were administered in the same form; and again, after 7 days more of rest, the same treatment was repeated, until a total of 36 injections had been administered.

Although an examination of the gastric contents was not possible because of the irritable condition of the patient, 10 drops of diluted nitrohydrochloric acid were given 3 times daily, before meals, in order to supply the deficiency of acid in the stomach, a symptom which is usually present in this class of patients.

It was very gratifying to observe that, after 25 days of this treatment, the patient's general condition began to improve; his appetite returned, and he thoroughly enjoyed his meals. The general nervous irritability was lessened to a noticeable extent, and he took pleasure in the company of his family and friends. The stools became less in amount, and were fewer in number. He gained in weight and strength, and began to approach normality in every respect. The discoloration of the skin began to disappear, giving way to a more healthy and natural color, as evidenced by the appearance of the lips, gums, and tongue. The improvement continued steadily.

Final Blood Examination. — The last blood examination was made in July, 4 months after the first, with the following results: Haemoglobin, 75%; erythrocytes, 3,552,000; color index, 1. There was an absence of achromatosis and granular basophilic degeneration, and only one poikilocyte was found in the whole field of examination. Leukocytes, 8,400. *Differential Count:* Polynucleophiles, 67%; polybasophiles, 2%; eosinophiles, 2%; small lymphocytes, 20%; large lymphocytes, 5%; large mononuclears, 0%; transitional forms, 4%.

Marked Improvement. — On July 20, this patient wrote me as follows: "I am observing strictly the diet you prescribed, and I am glad to report that I have gained twelve pounds in weight, and that all sprue symptoms have disappeared and my condition has improved wonderfully. I am not taking any medicine of any kind at present."

The last blood examination and the above excerpt, although a very brief account of his present condition, give a clear idea of the improvement after four months of treatment.

GENERAL COMMENT

Notwithstanding the fact that this case had been diagnosed as sprue, and the patient was still under that impression, it was evident that we were dealing with a case of *progressive pernicious anaemia*, caused by a gastro-intestinal sepsis provoked, in turn, by an altogether unbalanced and abnormal diet, and detrimental eating habits.

After a period of nine months of strict adherence to the dietetic treatment, the patient is enjoying splendid health, has returned to his former occupation, and is very active.

When I commenced the treatment of this patient he weighed only 114 pounds; and, although he had previously never weighed more than 124 pounds, he now weighs 142. This is about the normal weight for a man of his build and height. The haemoglobin is 88 per cent, and the red-blood corpuscles are nearly normal.

Even taking it for granted that liver as a food, through a yet unknown process, acts on the hematopoietic system and stimulates a reproduction of the blood cells, we still think that this alone, without the aid of a proper and well-balanced diet, could not have accomplished the rapid improvement obtained in this case.

The production of disease by dietetic indiscretions, especially in the Tropics, is becoming more and more common every day. Fortunately, it is something that can be prevented. If those living in the Tropics are taught to appreciate the value of a properly balanced diet, and are willing to cooperate, they will avoid many ills and ailments.

SPECIAL ACKNOWLEDGMENT

We are indebted to Dr. W. E. Deeks, General Manager of the Medical Department of the United Fruit Company, for his intelligent and tireless efforts to make the laymen, as well as the physicians, realize the importance of a well-balanced diet.

For more detailed and comprehensive information relative to the problem of diet versus disease the reader is referred to the interesting paper by Dr. W. E. Deeks, "Diet and Disease," published in the *Journal of Tropical Medicine*, May, 1927.

LOBAR PNEUMONIA

B. M. PHELPS, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

The mortality rate in lobar-pneumonia cases treated in this hospital during the year 1927 has been high, and was responsible for nearly 22 per cent of the deaths among hospital patients in this period. Some interesting data collected on these cases are submitted herewith:

TABLE I
SHOWING TREATMENT DATA

		Deaths	Per Cent
Total number of cases	55	21	38.18
Number treated with mercurochrome	33	11	33.33
Number treated with digitalis and caffeine sodium benzoate	8	7	87.50
Number treated with other drug combinations	14	3	21.42

Of the fatal cases who were treated with mercurochrome intravenously, 1 received the 1st dose of the drug the 1st day of hospitalization; 5 received it the 2nd day; 2, the 3rd day; 1, the 4th day; 1, the 9th day; and 1, the 14th day. Of these cases, 2 received a 2nd dose. The average dose given was 20 cc. of a 1% solution; the largest dose was 25 cc., and the smallest 15 cc. The average stay in the hospital was 6 days, including both the day of admission and the day of death. The shortest time was 3 days, and the longest was 16 days. All cases were males, of an average age of 32 years. The average period the patients were sick in the camps before they were admitted to the hospital was approximately $5\frac{1}{2}$ days.

For the fatal cases who were not treated with mercurochrome, the average stay in the hospital was 6.6 days; the shortest, 16 hours; and the longest, 13 days. Of these, 6 were females, and 4 were males; of an average age of 36.9 years. The average period of illness before hospitalization was approximately 6 days.

TABLE II
COMPARISON WITH PREVIOUS YEARS

Year	No. of Cases	No. of Deaths	Per Cent
1921	31	8	25.80
1922	60	39	65.00
1923	97	52	53.61
1924	101	43	42.59
1925	100	30	30.00
1926	63	23	36.50
1927	55	21	38.18

As will be noted above, there was a decrease of 8 in the number of cases admitted during 1927, as compared with 1926; but there was a 1.68 per cent increase in the fatality rate. There were about 125 more people living in our districts during 1927; therefore the morbidity rate was slightly decreased; and, if we omit a fatal case from the outlying Islands, the mortality rate for our division was approximately the same as last year.

TABLE III
SHOWING CASES BY NATIVITY

	Spanish Honduras	Nicaragua	Salvador	British Honduras	Mexico	Total
Cases	46	3	4	1	1	55
Deaths	15	2	2	1	1	21

It will be noted that no cases occurred among people from the temperate zone. As has been frequently noted, the Central-American laborer is especially susceptible to pneumonia, and shows a low resistance to the infection. The area of lung tissue involved is frequently most massive, as has been stated by Dr. Walter Jantzen in his Post-Mortem Summary for the year (see page 264). In this series of cases it was as follows:—

TABLE IV

	Cases	Deaths
1. All lobes of the right lung	5	3
2. Right lower lobe	16	3
3. Right upper lobe	1	0
4. Right lower and middle lobes	3	1
5. Right upper and middle lobes	1	0
6. Right and left lower lobes	6	4
7. Right and left lower and right middle lobes	1	1
8. Right upper, and both lower lobes	2	1
9. Right upper and lower lobes, and all of the left lung	1	1
10. Right lower lobe, and all of the left lung	1	1
11. Right middle lobe	1	0
12. Both lobes of the left lung	2	2
13. Left lower lobe	13	3
14. Left upper lobe	1	1
15. Left central lobe	1	0
Total	55	21

We have not observed any relationship between the occurrence of pneumonia and the changes in the seasons, which in this climate mean only a slight variation in the temperature but often a marked variation in the amount of rainfall.

COMMENTS

In reviewing the treatments, I find that nearly all the cases received digitalis. Codeine was also used in the majority of cases. Caffeine citrate, caffeine sodium benzoate, whiskey, strychnine, atropine, quinine, adrenalin, and camphorated oil were used in many cases for the relief of special symptoms, and were admin-

istered both alone and in combination. In two cases mercurochrome was not given until the patient was *in extremis*. Under such conditions, it is improbable that any benefit can be derived from an intravenous injection of this character.

TABLE V.
SHOWING SEASONAL INCIDENCE

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Cases . .	1	4	4	6	3	15	6	5	2	5	3	1	55
Deaths . .	0	2	1	4	1	7	2	1	0	2	1	0	21
Av. Rain- fall . .	18.16	2.84	1.41	.58	2.53	5.56	8.82	12.49	5.48	7.87	31.31	5.33	102.38
Mean Tem- perature	74.5	80	80.5	81	83	81	79.5	80	80	78.5	78	73	79

Twenty-two localities in the division were represented by pneumonia cases, the greatest number coming from Mame and Sambito Farms—8 and 7 cases respectively. As these are large camps, employing a considerable number of new or transient laborers, the occurrence of a large number of cases in them is not surprising.

The average period of hospitalization for patients who recovered (not including 1 case treated 79 days for other diseases) was slightly more than 19 days. There were apparently no cases of post-pneumonia myocarditis.

Transient albuminuria with hyaline casts in the urine was noted in nearly all the cases. Other complications and sequelae were numerous, and included empyema, lung abscess, pericarditis, purulent otitis media, meningitis, pyelitis, cystitis, malaria, splenomegaly, syphilis, abortion, arteriosclerosis, cirrhosis of the liver, aneurism, carbuncles, child-birth, intestinal parasites, and benign tumor of the intestine. In several cases, as will be noted in the Post-Mortem Summary (see page 264), these complications were more or less responsible for the death of the patient.

CONCLUSIONS

Using a variety of non-specific methods of treatment, we were unable to attain the comparatively low mortality rate of 1925, when all cases were given full doses of 1% mercurochrome intravenously as soon as the diagnosis was made. Symptomatic treatment of the disease is conceded as essential. Codeine, whiskey, and morphine, judiciously prescribed, do much for the comfort and sense of well-being of the patient. Mercurochrome should be given early in the course of the disease, and in full doses. In this division, individuals from the temperate zone, with the exception of chronic alcoholics, are rarely attacked with pneumonia.

The watchword in the treatment of this class of cases is *early hospitalization and early treatment*, preferably under the direction of one physician.

TETRACHLORETHYLENE IN UNCINARIASIS

A PRELIMINARY REPORT

O. T. BROSIUS, I. E. PEON, AND R. L. CARROLL

United Fruit Company Hospital

Almirante, Panama

A fairly conclusive estimate of the vermicial efficacy of chenopodium was made by one of us (O.T.B.*) in Colombia and reported in 1920. We consider that this estimate can be used, to a limited extent, as a standard of comparison for this series of tetrachlorethylene treatments. In the Colombian series, it was found that from 2 to 3 doses of chenopodium were necessary before the majority of the stool examinations were reported as negative for ova. The number of worms expelled after 2 doses of chenopodium had been given to 100 cases was 35,623. The largest number expelled by one patient was 2,554. Following the administration of one dose of the drug in these 100 people, 30,548 worms were expelled, or an average of about 305 worms per case.

It was concluded from the observations made on this series that one dose of the drug removed 84% of the parasites, and that the administration of a second dose increased our degree of success to 95.5%. We have generally considered that two doses of chenopodium represent a sufficient course of treatment for the average case of uncinariasis. It is not the purpose of this paper to discuss the use of chenopodium as a treatment for uncinariasis, but it is well to keep in mind the result of the Colombian series while considering the result obtained in this series treated with tetrachlorethylene.

The series in Colombia that were treated with chenopodium were people with a high incidence of uncinariasis and the infestations were heavy, as a rule. On the other hand, the medical dependents of our division have the hospital and dispensary services of the Company at their disposal. As a result of this, many individuals in the division area have been treated periodically with some form of vermifuge. Routine examinations of stools are made in Almirante Hospital on all cases at the time of their admission, and any that are found positive for uncinaria are given two treatments of chenopodium before they are discharged. The hospital cases of our second class wards found infested with uncinaria are the cases which comprise this series, irrespective of how often or how recently they may have been given a vermifuge. The following series of 24 cases admitted to the wards of this hospital, in addition to having other diseases or injuries, were found positive for uncinaria either alone or in combination with other intestinal parasites such as ascaris, trichocephalus, etc., As this is only a preliminary re-

* O. T. Brosius, "Diseases Due to Intestinal Parasites in Colombia, and Their Treatment," *Journ. A. M. A.*, June 26, 1920

port, and the Colombian and Almirante series are so unlike in character, it is deemed advisable to hold in abeyance a definite expression of opinion regarding the comparative efficacy of chenopodium and tetrachlorethylene. The result of administration of the latter is now presented in the following brief tabular manner:

SUMMARY

- 1. This series of 24 cases reveal uncinariasis as a primary diagnosis in 3 patients, and as a secondary entry in diagnosis in 21 patients.
- 2. A single dose of 3 cc. of tetrachlorethylene was administered in all but 3 cases. These repeated treatments can be found in the tabulated entries.
- 3. Reactions to the drug are listed as follows: severe, 2; moderate, 6; mild, 13; and no reaction in 3 cases.
- 4. Symptoms believed to be produced by the drug were as follows:

Dizziness	11 patients
Dizziness and abdominal pain or cramps	6 patients
Abdominal pain or cramps	3 patients
Nausea	1 patient

Vomiting of the drug occurred in 1 case.
- 5. 1,290 hookworms were found in the first 3 stools following the use of the drug, or an average of about 54 worms per case. The largest number of worms expelled by one person was 615.
- 6. 51 round worms (ascaris) were found, or an average of about 2 per case.
- 7. 12 whip worms (trichocephalus) were found, or an average of 0.5 per case.
- 8. In 7, or 29.16%, of the 24 cases no hookworms were found in the series of 3 stools examined after treatment. However, only 2 cases, or 8.3%, showed the ova of hookworms in the series of 3 stools examined after treatment. Thus, it appears that 91.7% of the series of cases were negative for the ova of uncinaria.

SECTION IV

SOME OBSERVATIONS ON INTESTINAL AMOEBIASIS DUE TO
INFECTION WITH ENTAMOEBA HISTOLYTICA*

WILLIAM M. JAMES, M.D., F.A.C.P.

Chief of Medicine, Herrick Clinic

Panama City, R. P.

That manifestation of intestinal ulceration due to infection with *E. histolytica* and known as amoebic dysentery has been fully described with reference to its etiology, pathology, symptomatology and diagnosis. The dysentery itself may be due to a generalized ulceration of the entire large bowel, with consequent colitis; or the ulcers may be confined to the sigmoid and rectum, and dysentery may follow this localized irritation.

For some years past it has also been known that quite severe and extensive amoebic ulceration of the caecum, or the flexures, or the other individual parts of the large bowel, may occur without dysentery, or the lesions may be only a few ulcers, localized or distributed. In such cases there may be occasionally a bloody stool, but more often diarrhoea alternating with constipation; and the symptomatology is varied in the extreme—so much so, that the diagnosis cannot be made except by the finding of the specific agent, *E. histolytica*.

The many phases of the life cycle of this parasite will later be referred to briefly.

I shall say at present only that in the small precystic and cyst-forming generations *histolytica* is difficult to find and, in fresh preparations from the stools, may easily be confused with similar phases of *Entamoeba coli*, *Endolimax nana*, and *Iodamoeba bütschlii*, all three of which are frequently seen in the examination of the stools, and especially in sub-tropical and tropical countries. Nearly twenty years of work on this subject have convinced me, and, I may add, others better qualified than myself, that the correct diagnosis of intestinal amoebiasis not associated with dysentery, and the proper identification of the four species of amoebae commonly found in the stools, is a task requiring long and special training; and is not to be entrusted, as it so often is, to the ordinary worker in the laboratory or the unstudied technician.

The milder cases of intestinal amoebiasis rarely come to autopsy, except when complications such as liver abscess or perforation occur, or when death results from accident or some intercurrent disease or infection. Although the association between amoebic abscess of the liver and dysentery has been notorious for

*The accompanying photographs were made for me at the Army Medical Museum in Washington, D. C. I wish to take this opportunity to express my warmest thanks to Major H. C. Callender, M.C., U. S. Army, Curator of the Army Medical Museum, and Sgt. Reeve, the photographer, for the many courtesies shown me. The photographs are part of a series intended to show the various lesions in the large intestine from the earliest necrosis to complete penetration and general destruction of the entire wall. It is hoped that the complete series will be published elsewhere in the near future.

many years—and indeed autopsy records show that when death follows untreated generalized intestinal ulceration due to *histolytica* infection there is abscess of the liver in over 50% of such cases—there are many reports of abscess of the liver on record without a history of dysentery; and at autopsy the pathologist found only a few scattered lesions, perhaps in the caecum or perhaps elsewhere in the large bowel.

These are cases of amoebiasis without dysentery; and the lesions, when uncomplicated by dysentery, may persist for years with few and intermittent symptoms. The pathologist, however, as far as I have been able to ascertain, has until very recently confined his researches to the gross and microscopic study of the larger lesions themselves, and it has not occurred to him that there may exist quite extensive damage to the mucous membrane of the large intestine that is not readily visible macroscopically, or at least only after very careful inspection. Such a condition has been suspected by several workers, particularly Dobell, Boeck, Wenyon, and Craig, and although it has been found as a very early condition in the cat, it has only recently been demonstrated in man. I shall endeavor briefly to indicate the importance of this conception of amoebiasis without dysentery.

In the stools of many apparently healthy and normal persons, sometimes with a history of previous dysentery or diarrhoea and less frequently in those who have never had intestinal troubles, enormous numbers of the small vegetative, precystic and cystic forms of *histolytica* are found; and these are quite as numerous as the larger vegetative forms found in acute dysentery. And it is not at all unusual to find the parasite persisting in quantity under these conditions. It is well known that these very small forms measuring from six to ten micra are derived from the large vegetative forms living higher in the bowel, and represent that phase of the life cycle preparatory to encystment.

Now, some authorities, among them some of those above mentioned, have held that *histolytica* is always a true parasite of the human tissues, and that it must invade these in order to live. But if the enormous numbers of the small generations found at times in the stools of apparently normal persons actually represent tissue invasion higher in the bowel, such invasion would certainly result in severe ulceration, with corresponding symptoms, and this does not inevitably occur. To explain this discrepancy it has been suggested that the invasion is confined only to the mucosa, and that the lesions heal readily; so that a continuous process of invasion and healing with complete restoration of the mucous membrane is taking place. These authorities do not agree that the parasite can live normally in the lumen of the bowel, and invade the tissue only at intervals—a hypothesis that would correspond to observed facts. They also maintain that the large number of active vegetative forms found in acute dysentery do not live and multiply in the lumen of the bowel, but contend that they generate in the tissues, and are thrown into the lumen by ruptures of the abscesses and discharges from the ulcers in the wall of the large intestine.

On the other hand, there are those, among whom at present I am found, who

hold that *histolytica* may at times live normally in the lumen of the upper part of the large bowel, and invade the tissues only under certain conditions, such as those which tend to irritate the mucosa, or when resistance is lowered.

We base our opinion on the grounds that the number of parasites frequently encountered, in mild amoebiasis as well as in acute dysentery, is out of all proportion to that found in sections of the intestinal wall in either case. Also, the well-known tendency of a mild amoebiasis to pass quickly into acute dysentery, following dietary indiscretions or lowered resistance due to inter-current disease, is evidence that something besides a latent tissue invasion has awakened a dormant infection into activity. It is only very recently, as I shall explain later, that proof has been obtained to show that extensive sections of the wall of the large intestine can be invaded without gross macroscopic lesions, and where no evidence of healing has been found, but rather a progressive damage.

Whichever hypothesis may be correct, there is one certain fact common to both, and concerning which practically all authorities are in agreement; and that is, whether it is always a tissue parasite, or whether it can live harmlessly for long intervals in the lumen of the bowel, *histolytica* is invariably an enemy of its host, actively or potentially, and should be treated as such whenever and wherever found.

Another important and frequently overlooked factor in *histolytica* infection is the relative immunity of the human host. It is indeed fortunate that this is true, since otherwise the ulceration would go on to perforation and most of these infections would be followed shortly by a fatal peritonitis. The muscle layers of the large bowel offer a very considerable resistance to the passage of the amoebae. One sees frequently large ulcers with few or no amoebae at the edges, and in many instances the damage is out of all proportion to the number of amoebae present. So true is this, that many believe a secondary bacterial infection from the lumen of the bowel is as responsible as the amoebae themselves, and frequently there is no correlation between the number of amoebae present and the amount of the damage, especially in amoebic abscesses of the liver, lung, brain, and spleen.

This fact may offer a clue to the successful treatment of amoebic infection. If the lesions in the wall of the large bowel can be made to heal, perhaps the amoebae in the tissues will die; and this can be demonstrated in pathological sections. Nests of amoebae in the tissues of the large intestine are invariably associated with abscess or ulcer formation communicating with the lumen of the bowel, although these nests may lie outside of the actual ulcerative process itself.

Conversely it may be said that, if the amoebae in the lumen of the bowel are removed and re-infection is prevented, the tissues will take care of their own amoebae.

The usual description of an amoebic ulcer is that it is flask or crater shaped, pointing into the lumen of the bowel, with its edges undermining the mucosa, and at times penetrating the muscle coats and even the serosa. According to

Dr. H. C. Clark, when the external muscle coat has been for the most part destroyed, the intestinal bacteria can pass through the serosa and bring about a localized or general peritonitis. This process is often accompanied by a considerable hypertrophy of the wall, especially of the submucosa, and, if the ulcer is advanced, by the formation of adhesions and bands.

The amoebae are said to gain entrance through the crypts of Lieberkühn, from the bases of which they wander into the submucosa, and pass out radially in that tissue, the end result being the flask-shaped or crater ulcer just described.

This description is essentially correct, as far as it goes, but it is not sufficiently inclusive. The amoebae not only penetrate the lumina of the glands, but they pass between the gland cells and the basement membrane, and not infrequently there is a direct invasion of the interstitial tissue as well. The result of this is a lysis and destruction of the mucosa, sometimes over large areas, without typical ulcer formation and without much invasion and destruction of the sub-mucosa. Dr. Lawrence Getz, pathologist to the Santo Tomas Hospital in Panama, has demonstrated this process over six inches or more of the mucosa, unaccompanied by ulcer formation or destruction in the sub-mucosa. He has also found the very earliest type of lesion—so early that it might be thought merely a post-mortem change, were it not for the amoebae found in the tissues.

Again, there may be an almost complete destruction of the mucosa, over large spaces, without ulceration and with very little invasion of the sub-mucosa. Such damage cannot fail to give rise to symptoms; and it is pathology of this type, with a few ulcers here and there, that is responsible for the clinical manifestations of amoebiasis without dysentery.

Notwithstanding the careful studies of recent years, the exact mechanism by which *histolytica* produces tissue destruction is still undetermined. The earliest form of damage is very similar to that produced by chemical agents, a true lysis of the cells, i.e., without a reaction accompanied by round-cell and *leukocytic* infiltration—a phenomenon which occurs later, and which may be due partly to bacterial invasion. But in all probability the amoebae secrete a ferment that has a true *lytic* action against the tissue cells; and this is especially true in the so-called sterile abscesses of the liver and brain, where there is great tissue destruction without secondary bacterial invasion. But even in very early lesions without secondary bacterial infection and round-cell infiltration, the damage is often out of proportion to the number of amoebae present; and if the lytic action of the ferment be so powerful here, one might look to see this action continued later. It does not appear that gland cells are more susceptible than interstitial tissue, since in the latter, and especially between the glands themselves, areas of necrosis with few amoebae are constantly found.

Very early there is also a marked congestion and at times a thrombosis of the terminal vessels of the circulatory system, especially of the capillaries and the very small radicles of the venous portal system. This has been explained by stating that in the crater or flask shaped ulcers there is a stasis of the blood supply due to pressure and round-cell infiltration.

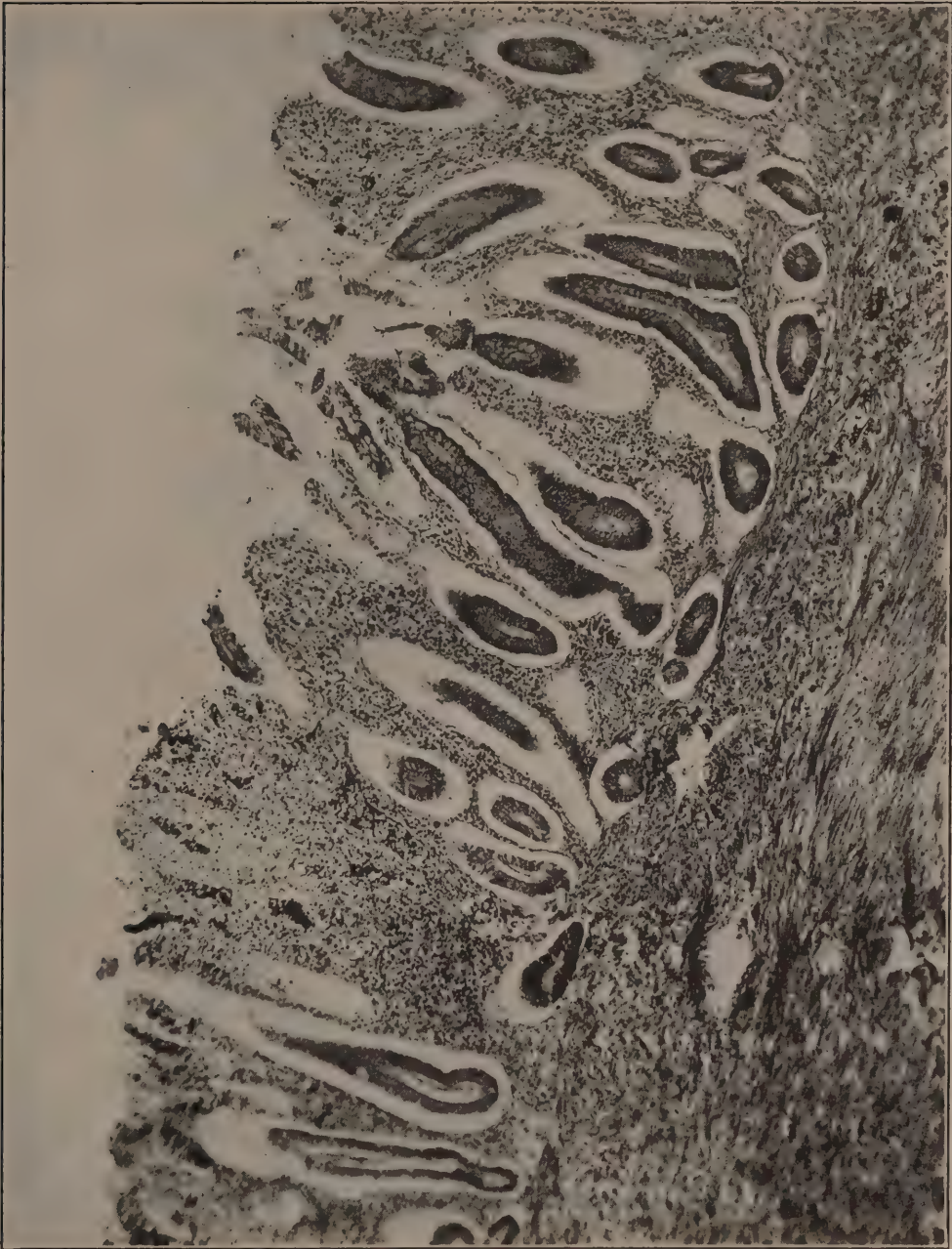


FIGURE 1—110X (Check No. 44937—59A)

Very early invasion of the intestinal wall. This photograph shows the congestion of the small capillary vessels of the mucosa and submucosa. In many places the mucosa is entirely normal. The only amoebae found in this particular area are those at the bottom of the glands at the extreme left, which are shown in detail in the next figure. There is, however, an early necrosis along the margin of the mucosa in the center of the photograph.

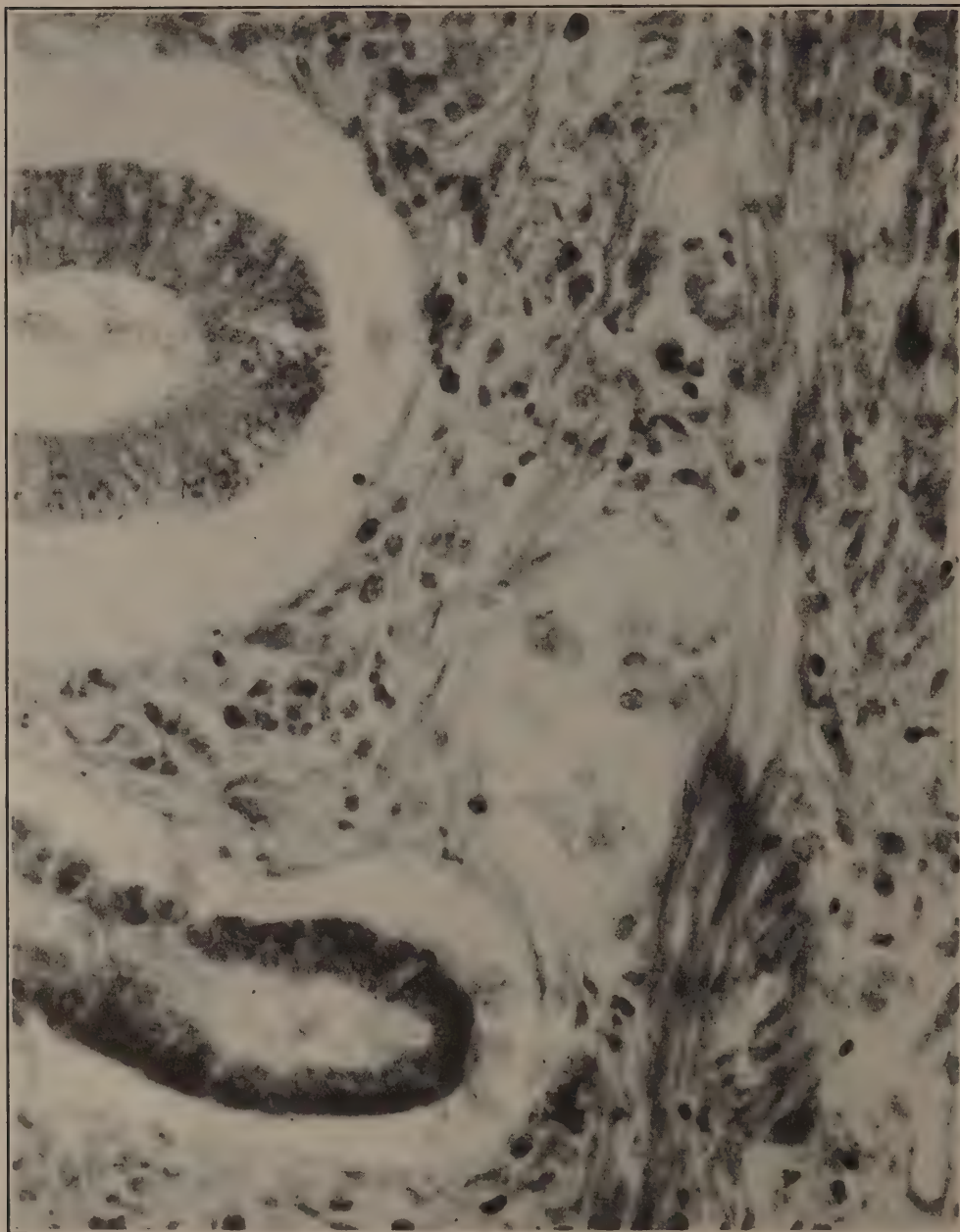


FIGURE 2—870X (Check No. 44986—59B)

High power detail of the preceding showing the amoebae at the bottom of the gland cells and in a small lymph space. Several cell nuclei resembling those of the amoebae can be seen in the submucosa and in the interstitial tissue of the mucosa, but careful microscopic examination shows that these nuclei belong to tissue cells.

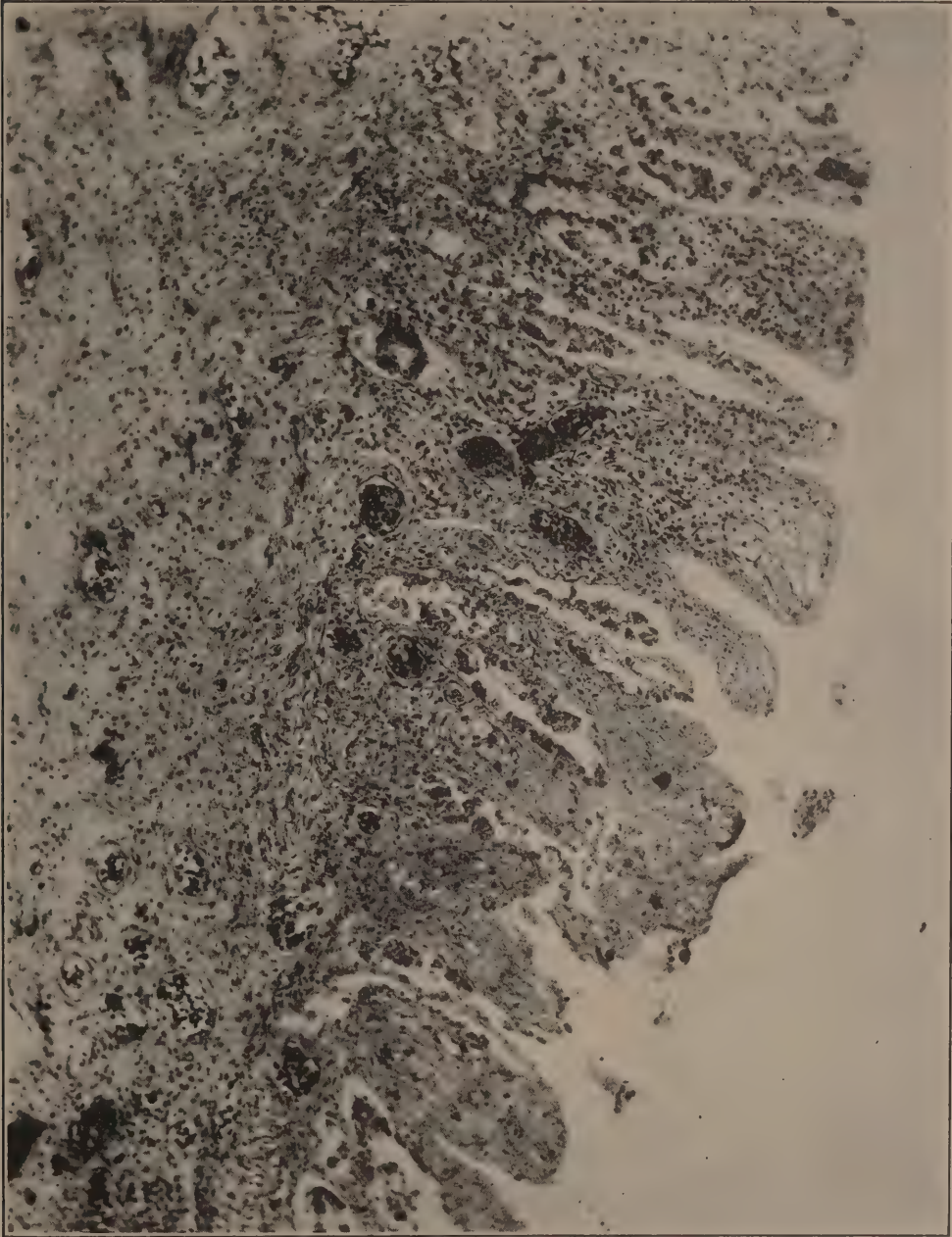


FIGURE 3—175X (Check No. 44705—7)

Early invasion of the mucosa without typical ulceration. This photograph shows very well the congestion of the capillary vessels of the submucosa and mucosa. To the right is a coagulation necrosis while at the extreme left there is a round cell infiltration. The mucosa is badly damaged and numerous amoebae are scattered throughout it, several of which can be plainly seen, even at this low magnification. The submucosa is in good condition and very few amoebae are found in it. Lesions such as this without further ulceration were numerous and extensive throughout the large intestine.

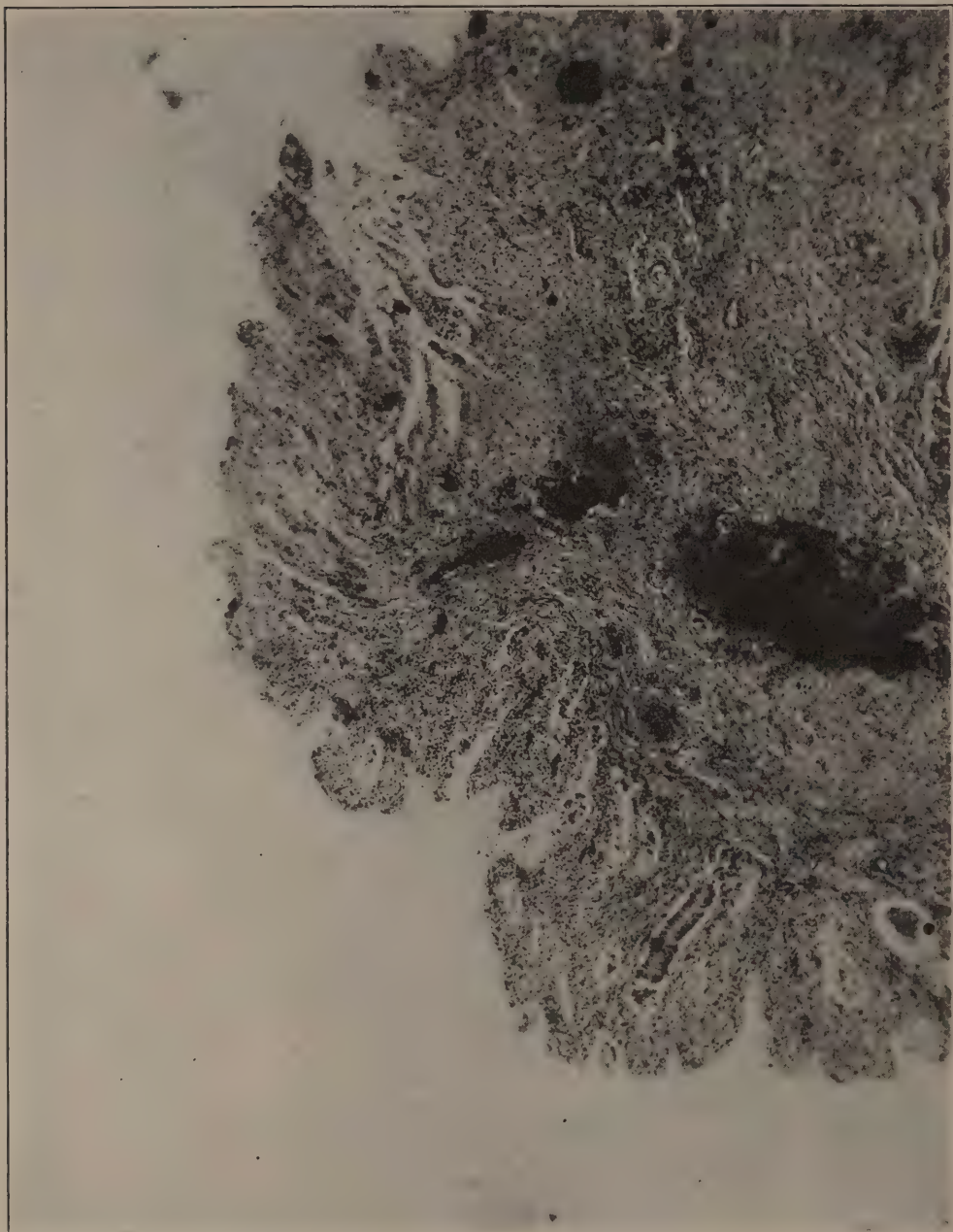


FIGURE 4—120X (Check No. 44703—5)

From the same autopsy as figure 3. A further stage of the same process as seen in figure 3, but more advanced. Here is shown extensive necrosis and destruction of the mucosa, with congestion of the small blood vessels and some round cell infiltration of the submucosa. The large black spot in the center is a staining artefact. Although the damage in the mucosa is extensive, the submucosa is for the most part in good condition. Lesions such as this throughout several inches of the large intestine cannot fail to produce symptoms and without doubt do not heal readily. In the rectum they are seen as small superficial erosions.



FIGURE 5—120X (Check No. 44716—15)

A small early ulcer in the mucosa which is cut on the bias. The surrounding tissue is normal except for a round cell infiltration, but there are amoebae in it and in the submucosa as well.



FIGURE 6—120X (Check No. 44701—4A)

Section of large intestine from a patient dying with amoebic abscess of the liver with ulceration of the cecum and small areas of ulceration in the colon. The amount of invasion in the large intestine was relatively limited. Amoebae can be seen in the glands at the center of the photograph and are fairly plentiful in the damaged mucosa. This photograph shows very well how much damage can be done to the mucosa before ulceration of the submucosa sets in.

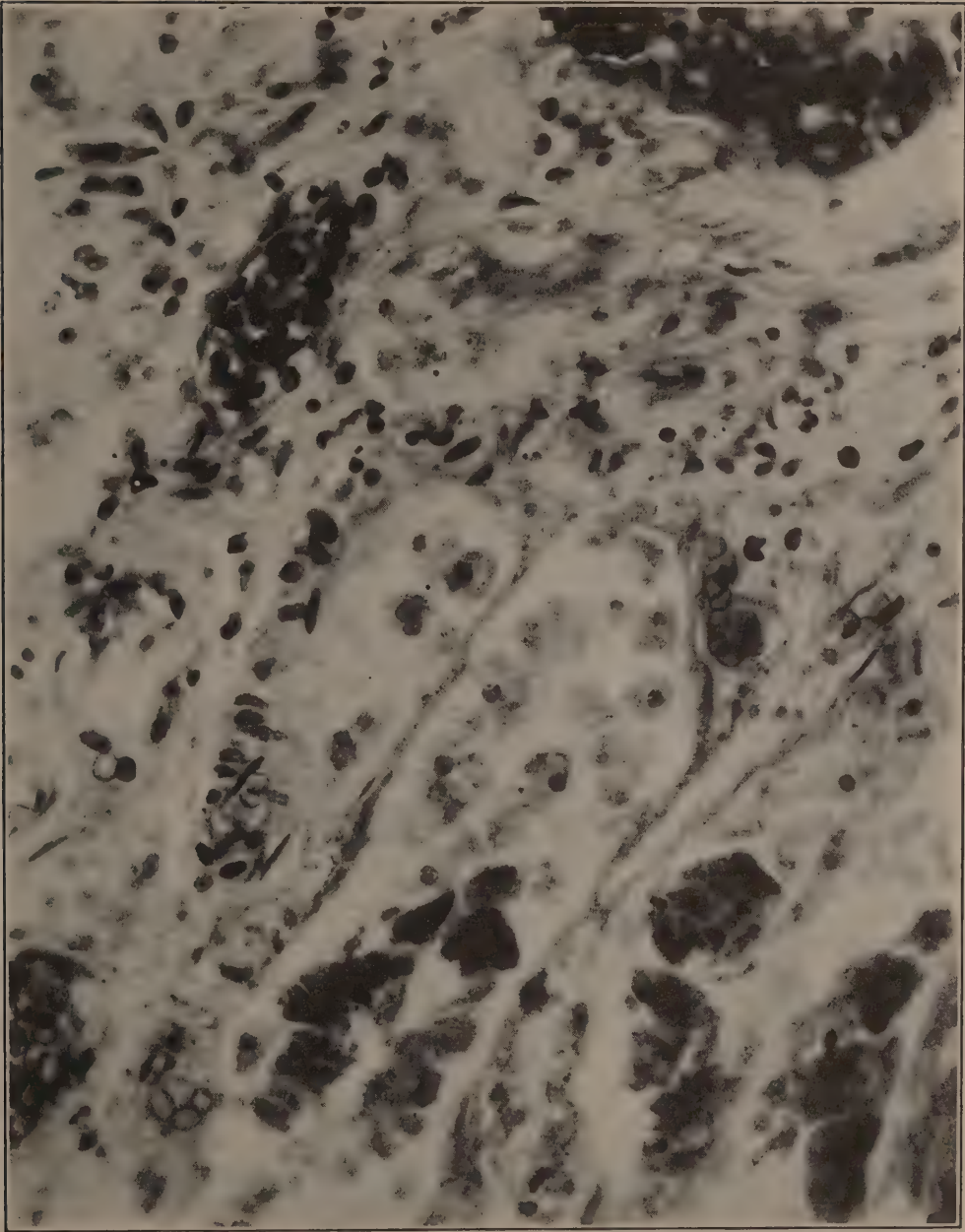


FIGURE 7—610X (Check No. 44702—4B)

A higher power detail of the preceding, showing two glands with the space between the gland cells and the basement membrane filled with amoebae. Although the destruction of the mucosa was very extensive, as is seen in the preceding photograph, only one or two areas such as this are found in the serial sections from this part. The tissue to the right of these glands in figure 6 contains very few amoebae.

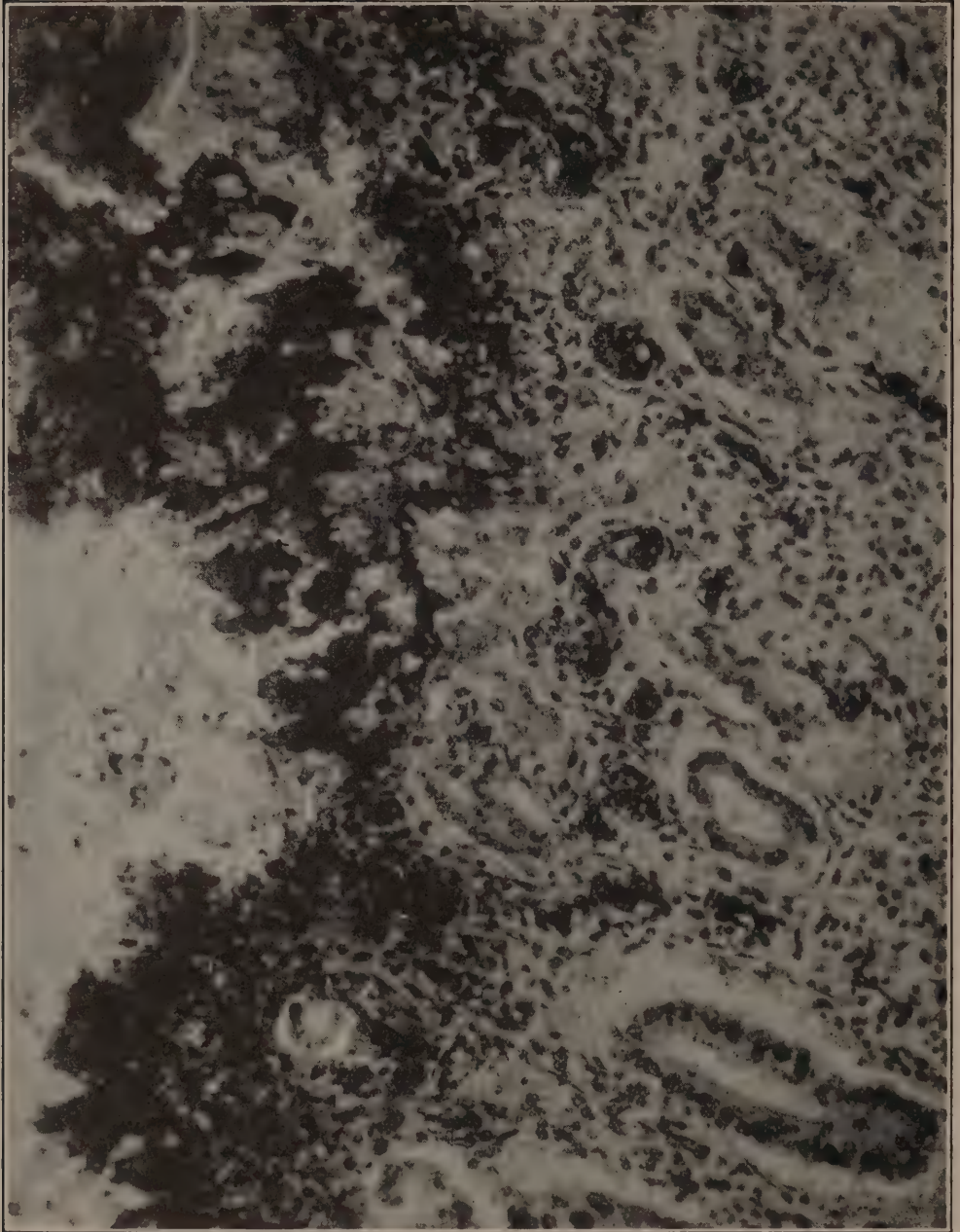


FIGURE 8—350X (Check No. 44700—3)

Early invasion of the mucosa with intense reaction. This invasion is superficial and there is probably a secondary bacterial invasion as well. Only a few amoebae are found along the margin of the ulceration. The submucosa was in good condition.

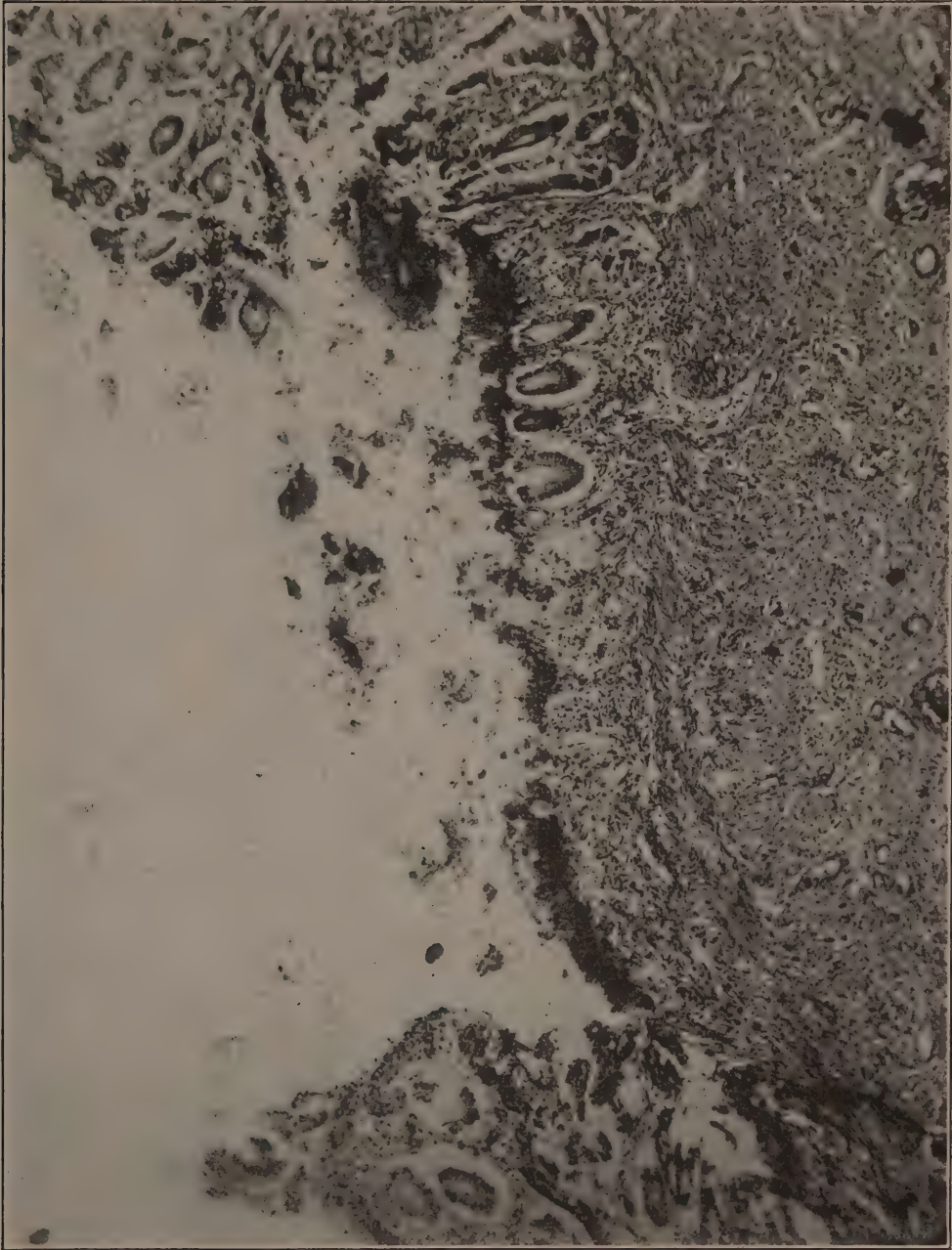


FIGURE 9—120X (Check No. 44717—16)

Another picture of superficial invasion of the mucosa without typical ulceration. It will be noted that the muscularis mucosae and the submucosa are in relatively good condition, although there is a definite round cell infiltration. A few amoebae are found in the submucosa.

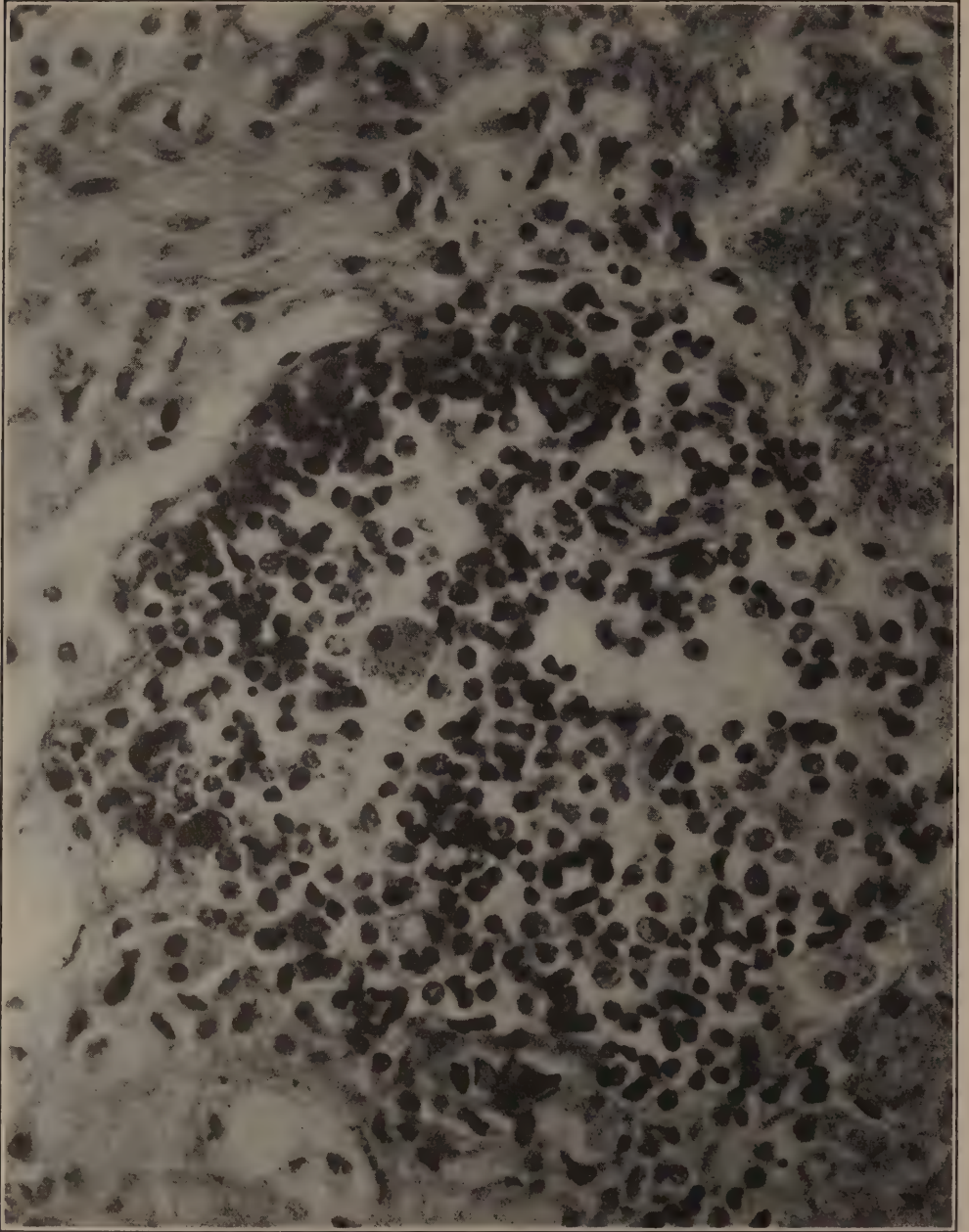


FIGURE 10—870X (Check No. 44709—9B)

This photograph shows invasion of a submucous lymph follicle by amoebae. One large amoeba is in the center of the follicle. There are several amoebae at the bottom of the center, and two more can be clearly made out at the edge of the lymphoid tissue in the upper right corner. Recently it has been claimed that *E. histolytica* has been found in the lymph glands in Hodgkin's disease. This photograph shows that when *histolytica* does invade lymphoid tissue it can readily and easily be distinguished from the surrounding lymphoid cells, even when there is a similarity between the nuclei of the parasites and those of the tissue cells.

But this congestion accompanies also the very earliest lesions, long before any mechanical factor can possibly be concerned, or any reaction due to secondary bacterial infection has taken place. It is a striking and constant phenomenon, and suggests that even prior to invasion of the tissue by the amoebae, these have brought about some irritation at the surface of the mucosa which results in this reaction. In its turn this brings up the thought that it is possible for *histolyticae* to remain latent in large numbers in the lumen of the bowel, but when the occasion arises, for reasons as yet unknown to us, they begin to secrete a ferment irritative to the mucosa; and, armed with this weapon of offense, hitherto unused, they begin their invasion.

I offer this suggestion solely for what it is worth. In truth, there is so much about the mechanism of *histolytica* infection which is at present hidden from us, and it is so difficult to reconcile or to correlate the known facts and recent findings with any hypothesis, that I feel sure we must work for a long time yet, before we can postulate a definite and satisfactory conclusion.

It is not possible within the limits of this paper to discuss all the factors in amoebiasis. If we have a definite knowledge of the essential facts of the pathology, it is possible to deduce from these most of the symptomatology. I shall merely state that this is variable in the extreme. Intestinal amoebiasis can simulate, directly or reflexly, practically every known gastro-intestinal disease, from simple indigestion, with flatulence and occasional colic, to obstruction and cancer. I have several times seen chronic amoebic infiltration of the caecum or the transverse colon mistaken for cancer, and with very good reason. Amoebic typhlitis and non-amoebic chronic appendicitis resemble each other so closely that the diagnosis often cannot be made until operation; and the two will frequently be found to be associated.

With respect to diagnosis, it is my own opinion that, except in cases of acute or sub-acute dysentery where the large, active vegetative form is readily demonstrated, the findings in the fresh stools should be checked with permanent preparations. This is because, in other types of amoebiasis, *histolytica* appears in the stools for the most part in the small vegetative or pre-cystic stage; and under such conditions, in fresh preparations, it is very easily confused with *nana*, *bütschlii*, and even with *coli*. It is true that a qualified expert, working with absolutely fresh material, may be able to distinguish between these four species in the examination of fresh material. But such experts are few and far between, and are not often found in the practice of medicine or in attached laboratories.

Dobell well intimates that, if the diagnosis can not be made correctly, it should not be made at all; and, since the treatment at best is tedious for the patient, as well as for the physician, a correct determination is of great importance. This determination can be made with a very high degree of probability in the wet-fixed or permanent preparations, by any one capable of reliable clinical laboratory work. In fresh material it can not be made at all except by those with long and special training and thoroughly familiar with the elements of microscopy. Yet

in more than one medical center untrained technicians are finding *histolytica* in a high percentage of fresh stool examinations, and clinicians are attributing a vast variety of *infirmities*, from Hodgkin's disease to chronic arthritis, to infestation with this parasite. .

Some of the errors in this work which I have encountered recently, "I would not have believed possible, had I not seen them myself"—to borrow an expression of that eminent authority, Prof. Clifford Dobell.

In conclusion, I wish to call attention to some work done recently by my colleague, Dr. J. J. Vallarino, radiologist to the Panama and the Santo Tomas hospitals and the Herrick Clinic.

Some four years ago, during his routine examinations in gastro-intestinal affections, Dr. Vallarino noted certain filling defects and solution of continuity in the walls of the large intestine. It occurred to him that these defects might represent lesions due to an amoebic infection, and he requested me to take up the laboratory examination in these cases. Dr. Vallarino does not claim that his observations are diagnostic of intestinal amoebiasis, but it is his opinion that when properly interpreted they will give the clinician an idea of the extent of the ulcerative process and the amount of damage which has been done.

Dr. Vallarino's studies are still in the preliminary stage, but his work has attracted the attention of many of the principal radiologists in the United States; and, personally, I find it of the greatest assistance in helping me to determine the extent of the lesions and the time necessary for their treatment.

FURTHER OBSERVATIONS ON THE "SYMBIOTIC FERMENTATION PHENOMENON." ITS USE IN THE DIFFERENTIATION OF CERTAIN MICRO-ORGANISMS AND IN THE IDENTIFICATION OF CERTAIN CARBOHYDRATES.

ALDO CASTELLANI

Professor of Tropical Medicine

Tulane University of Louisiana, New Orleans, La.

Definition of the Symbiotic Fermentation Phenomenon. — The so-called "symbiotic fermentation phenomenon" described by me may be defined as follows: "Two micro-organisms neither of which alone produces fermentation with gas in certain carbohydrates, may do so when living in symbiosis or when artificially mixed." I noted this phenomenon in 1904 and 1905, when I first became interested in the composition of baker's yeast; I observed that ordinary baker's yeast in Ceylon and England consisted, as a rule, of two or more organisms (saccharomyces and bacilli) living in symbiosis, and that, in a number of cases, baker's

yeast *in toto* gas-fermented a larger number of sugars than any of the isolated organisms. In recent years I have used pathogenic germs. The phenomenon takes place only using certain species of bacteria and fungi.

Baker's Yeast. — During the years 1904 and 1905 I became interested in the study of baker's yeast and in fermentation caused by yeast. I made the following observations:—

(1) Baker's yeast, both in the East and in London, is not a pure culture of a single species of yeast; it is generally composed of two or more species of saccharomyces plus one or two or several species of bacilli and at times cocci. The bacteria isolated from these samples of yeast do not produce gas fermentation in sugars; they produce simple acidity (probably lactic acid fermentation). In all the samples of commercial yeast I have examined in America, gas-forming bacilli are present.

(2) Comparing the fermentation reactions of baker's yeast used *in toto* as obtained from the bakers, sowing particles of the sample in the various sugars, with the fermentation reactions of the isolated pure cultures of the different species of saccharomyces and bacteria composing the sample, I found that the yeast *in toto* fermented a larger number of carbohydrates than any one of the saccharomyces and bacteria composing the sample.

(3) By mixing artificially all the organisms isolated from the sample of yeast, in certain cases the same fermentation reactions are obtained as with the yeast *in toto*. There are apparent exceptions, as shown by the following sample: From Orpington, a place in the country near London, I obtained in 1919 a sample of baker's yeast which gas-fermented a very large number of carbon compounds, including starch. I investigated the sample mycologically by plating on maltose and glucose agar, etc., and I isolated and grew in pure cultures what I believed to be all the organisms, saccharomyces and bacteria found in that sample. By mixing all the pure cultures I obtained the same fermentation reactions as with the sample of yeast *in toto*, except that the mixture did not touch starch. The experiment was repeated many times with the same results, until finally I had recourse to the following procedure: The surface of the glucose-agar plates, on which a minute particle of the yeast cake had been plated out, was washed with a little peptone water and the washing inoculated into starch. Fermentation took place, the inference being that probably some very minute colonies on the verge of invisibility had escaped my notice when investigating the plates and picking out all the colonies present; the thought also came to me that there might be an ultramicroscopic germ present.

(4) By mixing artificially a non-maltose fermenting saccharomyces (isolated from a sample of baker's yeast) with a bacillus, isolated from the same sample, producing acidity in maltose and several other sugars, but never gas in any substance, I obtained fermentation of maltose with production of gas.

(5) By mixing artificially two species of saccharomyces, neither of which gas-fermented saccharose, gas fermentation of this sugar was obtained.

Symbiotic Fermentation Phenomenon Using Pathogenic Organisms. — In recent years I have studied the phenomenon, using mostly pathogenic bacteria: bacilli and cocci, also a pathogenic yeast. In the present paper I will limit myself to giving the results of experiments, a number of them already published, carried out with the following organisms:

(a) *Bacilli.* — *B. typhosus*, *B. dysenteriae* Flexner, *B. morgani*, *B. canalensis*, *B. proteus* (strain P), *B. coli communior*, *B. kandiensis*, *B. vermiculoides*, *B. ceylonensis*, *B. coli communior* (var. *pseudo-coscoroba*), *B. paratyphosus* B.

(b) *Cocci.* — *Staphylococcus aureus*, two strains of *Streptococcus pyogenes*.

(c) *Fungi.* — *Cryptococcus graciloides*, *Aspergillus* sp.

The strain of *B. typhosus* I mostly used in the experiments was isolated from a case of typhoid fever, and showed all the typical serological reactions and biochemical characteristics of the typhoid bacillus; it was very highly agglutinated by typhoid serum; it did not produce gas in any carbohydrate; it produced acidity in glucose, levulose, maltose, galactose, mannitol, dextrin and sorbitol. Other strains of *B. typhosus* have been used by me with the same results.

The strain of *B. morgani* I generally use was isolated from a stool; it produces acidity and gas in glucose, levulose and galactose, but in no other sugar. *B. canalensis* produces gas only in glucose and levulose.

The Flexner dysentery bacillus used is serologically and biochemically typical.

The strain of *B. proteus* was isolated from a case of enteritis; it is motile and liquefies gelatine and serum rapidly; it produces acidity and gas in glucose, levulose, galactose, saccharose and glycerol; it does not produce acidity or gas in lactose, dulcitol, mannitol, maltose, dextrin, adonite, inulin, sorbitol, inosite, salicin, amygdalin, isodulcitol, or erythritol. As I have stated in other publications, the term *proteus* covers a group of closely allied bacilli, and not one species only. The strain I have used is very similar to the variety which I called *paradiffluens* (see Castellani and Chalmers' "Manual of Tropical Medicine," p. 943). In previous papers I have denoted it as *B. proteus* (P).

Technique to Put in Evidence the Symbiotic Fermentation Phenomenon. — The phenomenon may be put in evidence by using liquid media or solid media.

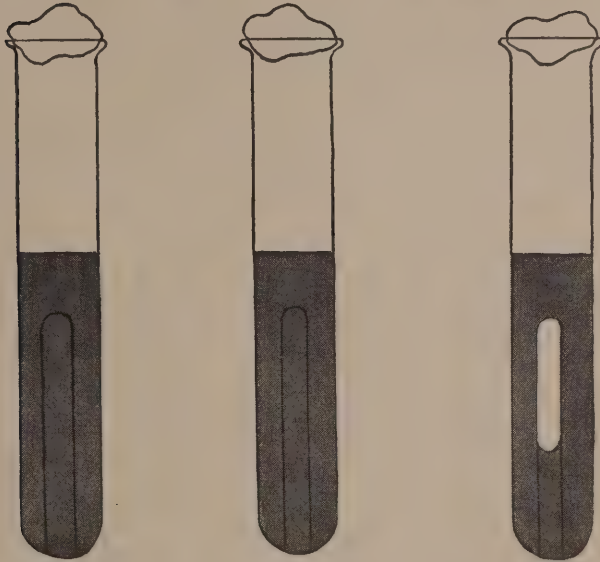
Liquid Media. — The phenomenon is easily put in evidence by the use of test tubes containing a Durham's fermentation tube, or saccharometers may be used. It is essential that the liquid media employed (maltose, mannitol, etc.) should be made with sugar-free peptone water, not broth, which usually contains a small amount of glucose. The tubes should be kept in the incubator at 37° C. for several days.

Solid Media. — The phenomenon is very evident when solid media are used. The solid sugar media (maltose-agar, mannitol-agar, etc.) are prepared in the usual way, but in the preparation of the agar sugar-free peptone water must be used, not broth, the latter medium always containing a slight amount of glucose.

When the phenomenon is positive a large number of gas bubbles will be present. With non-liquefying germs various sugar-gelatines may be used; the gelatine must be prepared by using peptone water, not broth, as broth always contains a slight amount of glucose.

SYMBIOSIS *B. TYPHOSUS* + *B. MORGANI*

MALTOSE



E. Fremaux.

B. TYPHOSUS

B. MORGANI

B. TYPHOSUS
+
MORGANI

FIG. 1—Action on Maltose of *B. typhosus* alone, *B. morgani* alone, and *B. typhosus* and *B. morgani*
B. typhosus alone—no gas
B. morgani alone—no gas
B. typhosus + *B. morgani*—gas present

Action on Maltose. — *B. typhosus* alone does not produce gas (acidity only); *B. morgani* alone does not produce gas (neither acidity nor gas). If a tube of maltose peptone water is inoculated, however, with *B. typhosus* and immediately after with *B. morgani*, and placed in the incubator at 35° or 37° C. for 48 hours, not only will acidity be produced, but also a large amount of gas. The same result is obtained if the two bacilli are previously mixed in plain peptone water and the peptone water mixture inoculated into tubes of maltose. The same

result is also obtained if *B. morgani* is added to *B. typhosus* 24 hours after inoculating with *B. typhosus*; if the interval is more than 24 hours, then the production of gas is not so constant.

When the two bacilli, *B. typhosus* and *B. morgani*, live naturally in close association the same phenomenon takes place, as shown by the following observation which I have related in previous papers:

The stool of a suspected typhoid case was examined bacteriologically in London, using MacConkey's medium plates. An exceptionally large number of white colonies developed; fifteen were picked out and were further investigated by replating, etc. Twelve of them consisted of two organisms—*B. typhosus* and *B. morgani*—three of *B. morgani* alone. The mixed cultures derived from the colonies containing both *B. typhosus* and *B. morgani* behave in the same manner: namely, when a loopful of the mixed growth is inoculated into a maltose peptone water tube, gas is produced.

Action on Mannitol.—As is well known, *B. typhosus* never produces gas in mannitol (acidity only). *B. morgani* has no action—no acidity or gas is produced. The mixture *B. typhosus* + *B. morgani* produces gas.

Action on Sorbitol.—*B. typhosus* alone does not produce gas in sorbitol (acidity only). *B. morgani* alone has no action whatever on sorbitol: it produces neither acidity nor gas. The mixture *B. typhosus* + *B. morgani* produces gas.

Action on Other Carbon Compounds Apart from the Above.—The reactions are seen at a glance in Table I, herewith, in which the fermentative characters are given of *B. typhosus* alone, *B. morgani* alone, and the mixture of *B. typhosus* + *B. morgani*.

From the table it is seen that certain sugars and other carbon compounds, which, when acted upon by *B. typhosus* alone, undergo a simple acid fermentation, and when acted upon by *B. morgani* alone do not undergo any fermentation, neither acid nor gas being produced, are capable of undergoing fermentation *with production of gas* when they are acted upon by the mixture of the two bacilli. In the carbon compounds in which *B. typhosus* alone does not produce acidity and *B. morgani* alone produces neither acidity nor gas, their mixture apparently produces neither acidity nor gas.

TABLE I

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannitol	Sorbitol
<i>B. typhosus</i> .	O	O	A	A	A	A	A	A
<i>B. morgani</i> .	O	O	AG	AG	O	AG	O	O
<i>B. typhosus</i> + <i>B. morgani</i> .	O	O	AG	AG	AG	AG	AG	AG

O = neither acid nor gas; A = acid; G = gas

SYMBIOSIS *B. TYPHOSUS* + *B. PROTEUS*

The strain of *B. proteus* (P.) used has no action on maltose, mannitol or sorbitol; it produces neither acidity nor gas in these substances.

Action on Maltose. — *B. typhosus* alone does not produce gas (acidity only). *B. proteus* (P) alone does not produce gas (neither acidity nor gas). The mixture *B. typhosus* + *B. proteus* (P) produces gas.

Action on Mannitol. — *B. typhosus* alone does not produce gas in this sugar (acidity only). *B. proteus* (P) has no action on it,—neither acidity nor gas is produced; their mixture, however, produces gas.

Action on Sorbitol. — *B. typhosus* does not produce gas (acidity only); *B. proteus* does not produce gas (neither acidity nor gas); their mixture causes production of gas.

TABLE II

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannitol	Sorbitol
<i>B. typhosus</i>	O	O	A	A	A	A	A	A
<i>B. proteus</i> (P)	O	O	AG	AG	O	AG	O	O
<i>B. typhosus</i> + <i>B. proteus</i> (P)	O	O	AG	AG	AG	AG	AG	AG

O = neither acid nor gas; A = acid; G = gas

SYMBIOSIS *B. DYSENTERIAE* FLEXNER + *B. MORGANI*

Action on Maltose. — *B. dysenteriae* Flexner does not produce gas (acidity only); *B. morgani* does not produce gas (neither acidity nor gas); their mixture produces gas.

Action on Mannitol. — *B. dysenteriae* Flexner does not produce gas (acidity only); *B. proteus* (P) produces neither acidity nor gas; their mixture produces gas.

TABLE III

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannitol	Sorbitol
<i>B. dysenteriae</i> Flexner . . .	O	O	A	A	A	A	A	O
<i>B. morgani</i> . . .	O	O	AG	AG	O	AG	O	O
<i>B. proteus</i> (P)	O	O	AG	AG	O	AG	O	O
<i>B. dysenteriae</i> Flexner + <i>B. morgani</i> .	O	O	AG	AG	AG	AG	AG	O
<i>B. dysenteriae</i> Flexner + <i>B. proteus</i> (P)	O	O	AG	AG	AG	AG	AG	O

O = neither acid nor gas; A = acid; G = gas

SYMBIOSIS *B. COLI COMMUNIOR* (VAR. *PSEUDO-COSCOROBA*)
+ *B. KANDIENSIS*

Action on Adonitol. — *B. coli communior* var. *pseudocoscoroba* does not produce gas (neither acidity nor gas); *B. kandiensis* does not produce gas (acidity only). The mixture *B. coli communior* + *B. kandiensis* will produce gas, though slowly. The tubes must be kept at 37° C for at least a week.

SYMBIOSIS *B. CEYLONENSIS* B + *B. MORGANI*

Action on Lactose. — *B. ceylonensis* B alone does not produce gas (acidity only); *B. morgani* alone does not produce gas (neither acidity nor gas); their mixture produces gas, though slowly.

SYMBIOSIS *B. CEYLONENSIS* B + *B. PARATYPHOSUS* B

Action on Lactose. — *B. ceylonensis* B alone does not produce gas (acidity only); *B. paratyphosus* B does not produce gas (neither acidity nor gas); their mixture produces gas.

SYMBIOSIS *B. CEYLONENSIS* B + *B. CANALENSIS*

Action on Lactose. — *B. ceylonensis* B alone does not produce gas (acidity only); *B. canalensis* alone does not produce gas (neither acidity nor gas); their mixture produces gas, though slowly.

SYMBIOSIS *B. CEYLONENSIS* A + *B. PARATYPHOSUS* B •

Lactose. — *B. ceylonensis* A does not produce gas (slight acidity); *B. paratyphosus* B does not produce gas; their mixture produces gas.

SYMBIOSIS *STAPHYLOCOCCUS AUREUS* + *B. MORGANI*

Action on Maltose. — *Staphylococcus aureus* alone (Ross Institute strain) does not produce gas in maltose (acidity only). *B. morgani* alone does not produce gas (neither acidity nor gas). Their mixture produces gas.

SYMBIOSIS *STREPTOCOCCUS PYOGENES* + *B. MORGANI*

Action on Maltose. — *Streptococcus pyogenes* (strain Public Health Laboratory, London) alone does not produce gas (acidity only); *B. morgani* alone does not produce gas (neither acidity nor gas). The mixture *Streptococcus pyogenes* + *B. morgani* produces gas, but it may take eight or ten days at 37° C. before the gas appears.

TABLE IV

	Lactose	Glucose	Levulose	Maltose	Galactose	Saccharoses	Mannitol	Dulcitol	Salticin	Inosite	Dextrine	Inulin	Sorbitol	Adonitol	Arabinose	Raffinose	Isodulcitol	Erythrite	Glycerol
<i>Cryptococcus graciloides</i> Castellani	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
<i>Bacillus vermiculoides</i> Castellani	A	A	A	A	A	O	O	O	O	O	O	O	O or A vs	O	O	O	O	O	O
Mixed culture	A	AGS	AG	AGS	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O

A = acid; G = gas; O = absence of acid and gas; S = slight; vs = very slight

SYMBIOSIS *STREPTOCOCCUS PYOGENES* + *B. PROTEUS* (P)

Action on Maltose. — *Streptococcus pyogenes* (strain Public Health Laboratory, London) alone does not produce gas (acidity only); *B. proteus* (P) does not produce gas (neither acidity nor gas). The mixture *Streptococcus pyogenes* + *B. proteus* produces gas, but it may take eight to ten days at 37° C. before the gas appears.

SYMBIOSIS *B. PARATYPHOSUS* B + *B. MORGANI*

Action on Lactose. — *B. paratyphosus* B alone does not produce gas (neither acidity to litmus nor gas); *B. morgani* alone does not produce gas, (neither acidity to litmus, nor gas); the mixture *B. paratyphosus* B + *B. morgani* will produce gas.

SYMBIOSIS *BACILLUS VERMICULOIDES* + *CRYPTOCOCCUS GRACILOIDES*

These two organisms live apparently in symbiosis, and it took me more than a year to separate them. The symbiotic mixture produces gas, though very slowly, in glucose, levulose and maltose. The cryptococcus alone does not produce either acid or gas; the bacillus alone produces acidity only. These results I published in the *Journal of Tropical Medicine and Hygiene*, June 15, 1925, and they are collected in Table IV, page 207.

SYMBIOSIS *ASPERGILLUS*, sp. + *B. MORGANI*

Maltose. — The aspergillus used (species undetermined) does not produce gas in maltose (acidity only); *B. morgani* does not produce gas (neither acidity nor gas); their mixture produces gas, though slowly.

Explanation of the Symbiotic Fermentation Phenomenon. — According to the recent work of Schütze and Harde, the phenomenon is due to one of the organisms causing formation of substances which are gas-fermented by the other. In the case of the symbiosis *B. typhosus* + *B. morgani* producing gas in maltose, this is apparently due to the formation of formic acid from maltose by *B. typhosus*, which is gas-fermented by *B. morgani*. Some very recent work carried out by Bhattacharyya would not seem, however, to support completely this explanation.

Symbiosis Producing Inhibitory Phenomenon. — The symbiotic fermentation phenomenon is an example of what might be called activating effects of symbiosis, but symbiosis, as I have noted in previous papers, may also be capable of producing inhibitory effects. For instance, *Monilia krusei* produces gas rapidly and abundantly in glucose; the symbiosis *M. krusei* + *M. talavensoides* produces it very slowly or not at all.

Indol. — A somewhat peculiar phenomenon has been observed by myself, Mendelson, Menon, Cerruti; *B. morgani* alone, as well known, produces indol, *B. typhosus* does not, *B. kandiensis* (strain R.I.) does not, or only a trace. The peptone water tubes inoculated with *B. morgani* + *B. typhosus* show presence of indol, the peptone water tubes inoculated with *B. morgani* + *B. kandiensis* usually do not, although the two organisms grow abundantly together. The method used to detect indol has been the sodium nitrite-hydrochloric acid one. Much further work on the subject is, however, necessary before coming to any definite conclusion.

USE OF THE SYMBIOTIC FERMENTATION PHENOMENON IN THE DIFFERENTIATION OF CERTAIN MICRO-ORGANISMS







The phenomenon may be used in the differentiation of various micro-organisms, as experimentally shown by myself and my co-workers, Mendelson, Peruzzi, Bhattacharyya, Menon, and Cerruti.

Differentiation of the Principal Types of Dysentery Bacilli. — The phenomenon has been used by me in the differentiation of the principal types of dysentery bacilli. The two principal types of dysentery organisms, Shiga and Flexner *sensu lato*, may be differentiated by using their symbiotic fermentation with *Bacillus morgani*. Shiga + Morgani will not produce gas in mannitol; Flexner + Morgan will produce gas. It may be said, generally, that the results of the symbiotic fermentation largely correspond to the results obtainable with simple acid fermentation, viz., there will be gas in those carbohydrates in which the organism to be identified will produce, alone, simple acidity; the presence of gas, however, is much more striking than simple acid fermentation; it may, moreover, in certain cases become rapidly evident, while the simple production of acid to litmus may be very slow. For instance, there has been some difference of opinion on the point as to whether *Bacillus dysenteriae* Shiga-Kruse produces acidity in maltose. In old textbooks on bacteriology the organism is described as producing slight acidity to litmus in maltose; in most of the modern books it is described as not producing acidity. The symbiosis Shiga + Morgan produces gas in maltose, and this is in favor of Shiga producing a certain amount, however, small, of acidity in that sugar.

Differentiation of B. dysenteriae Shiga-Kruse, *B. dysenteriae* Flexner, *B. dysenteriae* Y (Hiss-Russell). — The symbiosis Shiga + Morgan produces gas in maltose, not in mannitol; the symbiosis Flexner + Morgani produces gas in maltose and mannitol; the symbiosis Y + Morgan produces gas in mannitol, not in Maltose (see Fig. 2, page 210.)

Differentiation between B. typhosus and B. kandiensis. — Menon, under my direction, has carried out experiments on the differentiation of these two organisms by means of the symbiotic fermentation phenomenon. *B. typhosus* Eberth

and *B. kandiensis* Castellani are two organisms which have many points of similarity. They both belong to the genus *Eberthus*, as they are both motile, do not clot milk, do not acidify lactose, and do not produce gas in any sugar, although producing acidity in glucose, levulose, and several other carbohydrates. Menon, on my suggestion, has used *B. morgani* as the symbiotic or associated

	MANNITOL	MALTOSE
SHIGA + MORGAN	 -	 +
FLEXNER + MORGAN	 +	 +
"Y" + MORGAN	 +	 -

E.F.

FIG. 2—Differentiation of the three principal types of Dysentery Bacilli by the Symbiotic Fermentation phenomenon
+ = gas present; - = gas absent

organism. He has found that the symbiosis *B. typhosus* + *B. morgani* produces gas in maltose, dextrine and sorbitol, while the symbiosis *B. kandiensis* + *B. morgani* produces gas in erythritol, as noted by me some years ago, while the symbiosis *B. morgani* + *B. typhosus* does not. The results are collected in the following table:—

TABLE V

B	Maltose	Dextrine	Sorbitol	Erythritol
<i>B. typhosus</i> + <i>B. morgani</i> . . .	G	G	G	—
<i>B. kandiensis</i> + <i>B. morgani</i> . . .	—	—	—	G

G = gas produced; — = gas absent

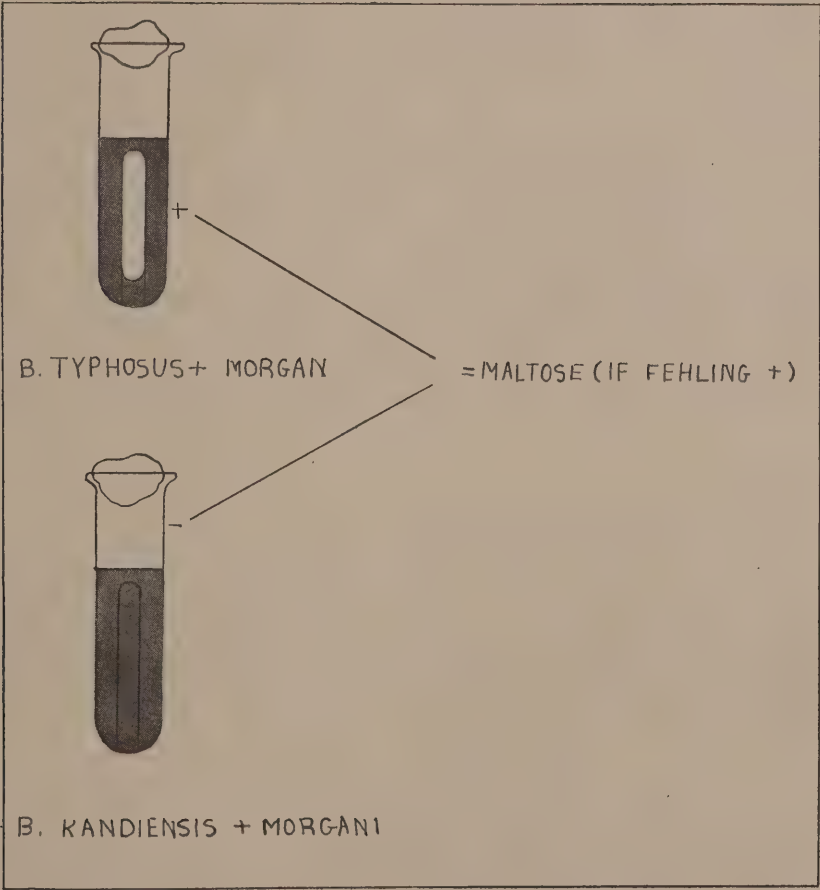


FIG. 3—Identification of Maltose by means of the Symbiotic Fermentation phenomenon
+ = gas present; — = gas absent

THE SYMBIOTIC FERMENTATION PHENOMENON IN THE IDENTIFICATION OF CERTAIN CARBON COMPOUNDS

The phenomenon has been used by me in the identification and differentiation of certain carbon compounds. For instance, a Fehling-reducing substance which is gas-fermented by *B. typhosus* + *B. morgani*, and not by *B. kandiensis* + *B. morgani*, is probably maltose. The explanation is as follows:—

The symbiosis *B. typhosus* + *B. morgani* and the symbiosis *B. kandiensis* + *B. morgani* produce gas in the same Fehling-reducing sugars except maltose, in which *B. typhosus* + *B. morgani* produces gas and *B. kandiensis* + *B. morgani* does not. If a Fehling-reducing sugar, therefore, is gas-fermented by *B. typhosus* + *B. morgani*, and not by *B. kandiensis* + *B. morgani*, the inference is that it is maltose. For the identification of maltose and other carbon compounds, however, the mycological method I devised in Ceylon, and later worked out in England with Dr. F. E. Taylor, is much simpler. All the details of the method may be found in the *Journal of Tropical Medicine and Hygiene*, July 15, 1926.

Recently I have found that the symbiotic phenomenon is useful in assisting in the identification of erythritol. This substance which, as is well known, is obtained from certain lichens, such as *Rocella tinctoria*, is a polyhedric alcohol $C_4H_6(OH)_4$ or $CH_2OH(CHOH)_2CH_2OH$. It is not fermented with production of gas by any organism I have tried; it is fermented, however, with production of gas by the symbiosis *B. kandiensis* + *B. morgani*, while it is not gas-fermented by the symbiosis *B. typhosus* + *B. morgani*.

Of course, the finding that a given substance is gas-fermented by the symbiosis *B. kandiensis* + *B. morgani*, and not by the symbiosis *B. typhosus* + *B. morgani*, is not sufficient to warrant the conclusion that we are dealing with erythritol, but if other characteristics of erythritol are present it may help in the identification.

The formula:—

<i>B. kandiensis</i> + <i>B. morgani</i>	G
<i>B. typhosus</i> + <i>B. morgani</i>	O

may indicate several other carbon compounds apart from erythritol, principally adonitol, isodulcitol, inositol. To exclude adonitol *B. lactis aerogenes* may be used; if gas is not produced, it is not adonitol; to exclude isodulcitol and inositol *B. paratyphosus* B may be used; if there is no production of gas, the substance is neither inositol nor isodulcitol.

RÉSUMÉ AND CONCLUSIONS

I. The symbiotic fermentation phenomenon described by me may be defined as follows: "Two organisms neither of which alone produces gas-fermentation in certain carbohydrates may do so when living in symbiosis or when artificially mixed."

The phenomenon was noted by me in 1904 and 1905, when I became interested in the composition of baker's yeast. In recent years I have used mostly pathogenic germs. The phenomenon takes place only when certain germs are used:

Examples: (1) *Bacillus typhosus* alone does not produce gas in mannitol (acidity only); *Bacillus morgani* alone does not produce gas in that substance (neither acidity nor gas). The mixture *Bacillus typhosus* + *Bacillus morgani* will produce gas.

(2) *Staphylococcus aureus* (Ross Institute strain) alone does not produce gas in maltose (acidity only); *Bacillus morgani* alone does not produce gas (neither acidity nor gas); the mixture *Staphylococcus aureus* + *Bacillus morgani* will produce gas in maltose.

II. The phenomenon may be put in evidence by using either liquid or solid media. In the preparation of the media, broth should not be used, as it contains a small amount of glucose; sugar-free peptone water should be used instead.

III. The phenomenon may be used in the differentiation of certain organisms and in the identification of certain carbon-compounds.

I shall be pleased to supply workers interested in the subject with cultures of the various strains of bacteria and fungi I have used in my experiments.

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Harde, H., Communication by Letter

Menon, "Differentiation between *B. typhosus* and *B. kandiensis* by means of Castellani's Symbiotic Phenomenon," *Journ. Trop. Med. and Hyg.*, Sept. 1, 1927

Peruzzi, M., *Annali Medicina Navale*, Anno xxxii, Vol. I, fasc. iii, iv, 1926

Schütze, H., Communication by letter

THE RESULTS OF SCHICK TESTS IN TELA, HONDURAS¹

W. H. TALIAFERRO, PH.D.

The comparative scarcity of clinical diphtheria in the Central American Tropics led the author to study in that region the antitoxic immunity to diphtheria as indicated by the Schick test. Schick tests were applied to 130 natives

1. This work was made possible through the courtesy of Dr. W. E. Deeks and the United Fruit Company. I am also greatly indebted to Dr. R. B. Nutter, Superintendent of the Tela Railroad Company's hospital in Tela, Honduras.

of Honduras and vicinity in 1926,² and to 300 others in 1927. In addition, 40 school children of American or American-Spanish parents, and 31 negro school children, were tested. The natives, as a whole, showed a very high percentage of immunes, while the American school children exhibited a much lower percentage of immunes. The present report gives the results of both years' work.

Prior to this work, at least two series of Schick tests have been carried out in the Tropics. Gomez, Navarro, and Kapauan³ tested 1,030 Filipinos living in government institutions in Manila; and Veira⁴ tested 785 children in São Paulo who were mostly institutional inmates. Furthermore, Doull, Ferreira, and Parreiras⁵ have just published the results of 1,217 tests on inhabitants of Brazil, where clinical diphtheria is also scarce. In general, all of these investigators have found a high percentage of immunes. Detailed references to their data, as well as to the various studies of Zingher in the United States, are referred to later in this article.

The diphtheria toxin for the first series of tests was obtained from the H. K. Mulford Company, and that for the second series from the United States Standard Products Company. In carrying out the tests the usual procedure was employed, i.e., the toxin was injected intradermally on the right forearm, and the heated toxin control on the left. In all cases, the material was diluted with saline, so that one test dose was contained in 0.1 c.c. To insure against deterioration, each batch of diluted material was tested on one or more of the several Americans at the hospital in Tela, who gave well-defined positive reactions.

The best general sample of the population of Honduras and neighboring Central American states is the series of 430 tests given in Table 1, page 216. The 196 children, between the ages of 6 and 14 years, attended schools in the native town of Tela,⁶ and their native states were the following: Honduras 193; San Salvador, 2; and Nicaragua, 1. Almost all of the 234 persons of 15 years and over were patients of the Tela hospital, although a few from 15 to 19 years of age were either attendants of the native school or employees of the hospital. Their places of nativity were: Honduras, 170; San Salvador, 41; British Possessions in the Caribbean (negroes), 15; Guatemala, 6; Mexico, 1; Panama, 1; and Porto Rico, 1. It is to be noted that the patients of the hospital are not institutional inmates, in the ordinary sense. They are chiefly natives employed on the banana farms around Tela, who come into the hospital for medical attention.

Irrespective of racial factors, it has been generally found that children of cities show a lower percentage of susceptibility than those of rural communities;

2. *Fifteenth An. Rept.*, Med. Dept., United Fruit Co., 1926, p. 183

3. *Philippine Journ. Sci.*, 1922, 20:323

4. *Instituto de Hyg., São Paulo, Boletim No. 21*, 1924, p. 14, quoted from Doull, Ferreira and Parreiras⁵

5. *Journ. Prev. Med.*, 1927, 1:513

6. The work in these schools was arranged through the kindness and cooperation of Dr. Arturo Zelaya of Tela.

that within cities, the more congested the area, the lower the susceptibility; and that the long-continued close contact in institutions is peculiarly adapted to an especially low rate of susceptibility. Since the native population of Honduras exhibited a very low susceptibility, it seemed pertinent to compare the results of the Schick test obtained there with the very extensive data collected by Zingher^{7,8} on school children of New York City and on inmates of institutions in New York State. As the results of the findings in the six institutions he studied are rather variable, I have combined them.

From the three studies of the Schick test in the Tropics I have used only the data of Doull and his associates, because the other studies were made chiefly upon institutional inmates and approximate the low rate of susceptibility found in the New York institutions. A comparison of these data with the data from Honduras, all of which are given in Table 1, page 216, indicates that among the school children in the three age groups 6 and 7, 8 and 9, and 10 to 14 inclusive, the percentages from the native school in Tela, Honduras (3.4, 17.6, and 7.7) are much lower than those of corresponding age groups in New York City schools (46.7, 34.3 and 26.1); and, as far as the data go, are approximately as low as those collected from the institutions of New York State (9.6, 9.7 and 5.4). Furthermore, the Honduras figures are consistently lower than those for the school children in Nictheroy, Brazil (29.3, 27.2 and 23.3 per cent).

Moreover, in the higher age groups (15 and over), the percentages from Honduras are consistently lower (4.0, 4.3, 1.4) than those from one institutional group given by Zingher,⁹ or than the group of soldiers and police of Rio de Janeiro, as given by Doull, etc. (see Table 1).

In other words, the present series of tests corroborates the findings of other investigators, in that they indicate a high grade of antitoxic immunity in tropical countries where clinical diphtheria is relatively scarce. Furthermore, they indicate that a higher grade of immunity exists in Honduras than in other parts of the Tropics so far tested, and that the Honduras immunity approaches the immunity exhibited by institutional groups. It seems probable that the high immunity may be connected, (a) in the case of the school children, with the poor living conditions in the little town of Tela; and (b) among the adults, with the housing of the laborers in barracks on the banana farms. It would be interesting to compare these Coastal natives with those residing in the interior of the country.

The Tela Railroad Company's settlement at Tela, or the so-called "American Tela," is separated from the native town by the Tela River. Table 2, page 217, gives the results of tests on 40 children in the white school of "American Tela," which is attended by children of American, English, and the higher-class Spanish

7. *Arch. Int. Med.*, 1917, 20:392

8. *Amer. Journ. Dis. Child.*, 1923, 25:392

9. In making these comparisons, I have used only the figures for males, as my series contained very few females.

TABLE I
RESULTS OF SCHICK TESTS IN TELA, HONDURAS, AS COMPARED WITH OTHER LOCALITIES

Age	Natives of Central America (430 Tested)						New York City, Public and Parochial Schools (141,222 Tested) ¹⁰ (Zingher ¹¹)	New York State Institutions (4,038 Tested) ¹⁰ (Zinger ¹¹)	Brazil School Children, Soldiers, and Police (871 Tested) ¹¹ (Doull, et al. ¹²)
	Male		Female		Both Sexes		Per Cent Positive	Per Cent Positive	Per Cent Positive
	Number Tested	Number Positive	Number Tested	Number Positive	Per Cent Positive	Number Positive			
6 and 7	19	0	10	1	3.4	1	46.7	9.6	29.3
8 and 9	28	5	23	4	17.6	4	34.3	9.7	27.2
10 to 14, incl. .	74	4	42	5	7.7	5	26.1	5.4	23.3
15 to 19, incl. .	17	0	8	1	4.0	1		14.7*	8.8*
20 to 29, incl. .	126	6	12	0	4.3	0		7.8*	10.0*
30 and over . .	58	1	13	0	1.4	0		6.3*	8.0*

* Males only

¹⁰ The figures for the ages 6 and 7 are composite data for the N. Y. Foundling Hospital, St. Agatha's Home, Nanuet, N. Y., Dominican Convent, N. Y., Catholic Protectory, and Institute of Mercy; those for the ages 8 and 9, and 10 to 14 inclusive, are for the 4 institutions last named; and those for the ages 10 to 19 inclusive, 20 to 29 inclusive, and 30 and over, are for the males in the Manhattan State Hospital.

¹¹ The data for the ages 6 to 14 are taken from the data for Nictheroy school children, and those for the ages 15 and over solely from the data for the soldiers and police.

TABLE 2
RESULTS OF SCHICK TESTS IN "AMERICAN TELA," HONDURAS

Age	White School Children (40 Tested)						Negro School Children (31 Tested)					
	Male			Female			Both Sexes			Male		
	Number Tested	Number Positive	Number Tested	Number Positive	Number Tested	Number Positive	Per Cent Positive	Number Tested	Number Positive	Number Tested	Number Positive	Per Cent Positive
4 and 5	3	2	3	3	3	3	83.3					
6 and 7	4	2	6	6	6	6	80.0	5	0	4	1	11.1
8 and 9	4	1	2	2	2	2	50.0	5	1	4	3	44.4
10 to 14, inclusive . . .	8	3	10	5	5	5	44.4	4	2	9	3	38.4

people, who hold executive positions with the Tela Railroad Company. The nationality of the children was as follows: American 15, English 5, American-English 1, Spanish 11, and American-Spanish 8. Although the numbers are very small, they consistently indicate a very much higher percentage of susceptibility than was found in native Tela. Taking the 34 children between 6-14 years, inclusive, in "American Tela," 55.8 per cent were positive, as compared with 9.6 per cent of the 196 children of the same age in native Tela. This higher rate of susceptibility among children attending the white school in "American Tela" is undoubtedly connected with the fact that their living standards are much higher, and that they live in a much less congested community.

In "American Tela" there is also a negro school; and 217 tests were run on the children attending it. (See Table 2, page 217). The parentage of these children was: Negroes from the British Possessions in the Caribbean, 18; negroes from the British West Indies, mixed with Spanish, 6; and chiefly of Spanish descent, 7. The scale of living of these children was much lower than that of the pupils in the white school, but it was probably higher than that found in native Tela. It is therefore interesting that their susceptibility is intermediate between that of the school children of native Tela and that of the white children in "American Tela." The 31 negro children, aged 6 to 14 years, inclusive, showed 32.2 per cent positive as compared with 55.8 per cent for the white children, and 9.6 per cent for the children in native Tela.

SUMMARY

1. Schick tests on 430 persons at Tela, Honduras, including native children attending the public school and native employees of the Tela Railroad Company, showed a much lower percentage of positives than in large centers in the United States, such as New York City. The rate of immunity approximated that of institutions of New York State and of the Tropics.

2. Tests on 40 children, chiefly of American and English parentage, attending the white school in "American Tela," showed a much higher percentage of positives; (ages 6 to 14 years, inclusive, showed 55.8 per cent positive, as compared with 9.6 per cent for the children of the native school).

3. Tests on 31 children attending the negro school in "American Tela" showed a high, but intermediate, percentage of positives (6 to 14 years inclusive, 32.2 per cent).

HYPERSENSITIVENESS TO HELMINTH PROTEINS

CUTANEOUS TESTS WITH PROTEINS OF ASCARIS,
HOOKWORM AND TRICHURIS IN HONDURAS¹

FRANCES A. COVENTRY AND WILLIAM H. TALIAFERRO

A great deal of work has been done in recent years on the general subject of hypersensitiveness, but most of the experimental work has dealt with sensitivity to such proteins as the pollens causing hay fever and to those involving serum sickness and food idiosyncrasies; and until quite recently, very little had been done on hypersensitivity to the proteins of parasites. The present study of cutaneous hypersensitiveness, especially to ascaris and hookworm proteins, was made to ascertain its incidence in a population with a high rate of infection and to test its efficacy as a diagnostic measure. Furthermore, precipitin tests were run on a large number of the individuals to ascertain if there was any correlation between hypersensitiveness and antibody production.

The term hypersensitiveness has been used to embrace a large group of conditions which need not be discussed in detail here. In many ways the hypersensitiveness to worm proteins is similar to that in hay fever and asthma, conditions designated by Coca² as atopy. This author differentiates atopic hypersensitiveness from such other abnormal hypersensitive conditions as anaphylaxis and hypersensitiveness of the tuberculin type and from "normal" hypersensitiveness such as *Dermatitis venenata* and ordinary serum disease. Atopic hypersensitiveness is manifested in a number of clinical forms, such as hay fever and asthma, and probably also urticaria and eczema. It is probably an inherited condition. In these conditions the skin and conjunctiva are sensitive to the exciting agent. Introduction of the material into the skin either by intradermal injection or by contact with a scarified surface results, in a sensitive individual, in the formation within a few minutes of a wheal or welt surrounded by a zone of erythema. The ophthalmic reaction need not concern us here.

Although no antibody mechanism has been demonstrated as the basis of this sensitivity, the blood of sensitive individuals contains a thermo-stable property which, upon injection into the skin of normal persons, causes the injected area to become specifically sensitive. This property behaves so differently from true antibodies that Coca designates it a "reagin."

The passive transfer of skin sensitivity has been demonstrated by numerous experimenters. Prausnitz and Küstner³ passively transferred local hyper-

1. We are greatly indebted to Dr. W. E. Deeks and the United Fruit Company, through whose courtesy this work was done at the Tela Railroad Company's hospital in Tela, Honduras. We also wish to express our sincere thanks to Dr. R. B. Nutter, Superintendent of the hospital and to his staff, and to Dr. Lucy Graves Taliaferro of the University of Chicago, for their invaluable assistance.

2. "Essentials of Immunology," Baltimore, 1925

3. *Centralbl. f. Bakt., Orig.*, 1921, 86:160

sensitiveness to fish protein to the skin of a normal individual, although the serum of the sensitive patient showed no precipitating, complement binding or neutralizing antibodies. De Besche¹ similarly passively transferred specific sensitivity to horse serum, a wheal and erythema appearing in the passively sensitized areas of skin.

A few experiments appearing to link some forms of hypersensitivity to parasitic worms with atopic hypersensitivity have been done. Thus, Rackemann and Stevens² tested two ascaris-sensitive but uninfected individuals. Immediately after intradermal injection of a saline extract of ascaris, these individuals developed a typical wheal and urticaria. No precipitins could be demonstrated in their blood, but the presence of "reagins" was demonstrated; for when normal persons were first injected intradermally with their sera, and 24 hours later with ascaris antigen at the same site, wheals and urticaria appeared within 20 minutes.

Also, some recent investigators, notably Goudsmit,³ Ithurrat and Calcagno,⁴ Dew and Williams,⁵ and Dew, Kellaway and Williams,⁶ working with an intradermal test devised by Casoni⁷ for the diagnosis of hydatid infection, lay stress on the constant feature of the immediate wheal reaction and advocate its use as a diagnostic measure rather than the later erythema and induration, which they consider more variable. Coca⁸ believes that this hypersensitiveness to worm protein differs from the atopic type, in that all persons can form the reagin.

Sensitiveness to ascaris has been noted and studied by numerous investigators. Among the first, Huber⁹ reported on the toxic effects of horse and human ascaris. Goldschmidt,¹⁰ himself sensitive to both, studied and described the reactions of numerous zoologists who had worked with the worms and were susceptible to them. Flury¹¹ made an extensive chemical and toxicological study of ascaris, but was not familiar with the urticarial skin reactions. Ransom, Harrison and Couch,¹² studying the nature of the substance in ascaris which causes symptoms in susceptible persons, demonstrated, by cutaneous scratch tests on ascaris-sensitive persons, its presence in the albumen fraction and in the so-called protein-free filtrate of aqueous extracts. Furthermore, in scratch testing 20 white adults, they obtained 4 positive reactions on people who had been in contact with ascaris during periods of from 5 to 25 years but

1. *Amer. Journ. Med. Sci.*, 1923, 166:265

2. *Journ. Imm.*, 1927, 13:389

3. *Nederlandsch. Tijdschr. v. Geneeskunde*, 1924, 68 : II A : 1,235

4. *Presse Med.*, 1923, 31 : III : 765

5. *Med. Journ. Australia (Sup.)*, 1924, 1 : 113.

6. *Med. Journ. Australia*, 1925, 1 : 471

7. *Folia Clin., Chim., e Micr.*, 1911, 4 : 5

8. Jordan and Falk, "The Newer Knowledge of Bacteriology and Immunology", Chicago, 1928

9. *Deutsch. Arch. f. Klin. Med.*, 1870, 7 : 450.

10. *München. Med. Wchnschr.*, 1910, 57 : 1,991

11. *Arch. Exp. Path. u. Pharmacol.*, 1912, 67 : 275

12. *Journ. Agric. Res.*, 1924, 28 : 577

who had no history of infection. One of these had been previously unaware of his sensitivity. On the other hand, some of the non-reactors had also been in contact with ascaris, although they had never experienced any disagreeable effect, and several others had a history of ascaris infection. More recently, Fülleborn¹ has made a number of investigations on cutaneous reactions in various helminth infections. He reports specific immediate reactions in strongyloides patients tested with strongyloides extracts by the scratch method. In a second report,² he extends his work and concludes that the test is utilizable diagnostically, although its value is somewhat lessened by the fact that sensitivity may be present for a very long time after the cessation of infection. Similarly, with ascaris skin tests on ascaris patients, he finds that sensitivity lasts at least four years after infection with demonstrable freedom from infection in the interval, and concludes that a positive skin reaction with ascaris extracts indicates either a past or present ascaris infection.

MATERIALS AND METHODS

A. The ascaris material used was either pig or human ascaris (*Ascaris lumbricoides* Linn. 1758). Whole live worms were rinsed carefully several times in phenol and in saline, ground in a meat-chopper, dried over sulphuric acid or calcium chloride *in vacuo*, and ground at intervals of a day or two with mortar and pestle until a fine powder was produced. This was kept, until needed, in small sealed bottles. The test solution, which was kept several days under toluol in the refrigerator before use, consisted of 0.1 gram of powder in 10.0 cc. of Coca's extracting solution (0.5% sodium chloride, 0.05% sodium bicarbonate and 0.4% phenol crystals). The supernatant without any further treatment was used for skin tests; but for precipitin tests it was either filtered through hard filter paper (Whatman's No. 50) or centrifuged at high speed until clear.

B. Hookworm material was obtained from two sources: (1) Adult worms³ were isolated from a stool after treatment, washed in saline, placed directly in ether and shipped from Alabama to Honduras, where they were dried *in vacuo* and pulverized in an agate mortar; (2) living worms were isolated from a case at autopsy, rinsed in saline, dried *in vacuo* and ground. The test solution contained 0.15 gram of powder in 3.0 cc. of Coca's solution, and was kept under toluol in the refrigerator until needed.

C. Trichuris test extract was prepared from living *Trichuris trichiura* which were isolated from a case at autopsy, rinsed in saline, dried *in vacuo* and ground. The test solution was of the same strength and in the same diluent as the hookworm extract.

1. *Arch. f. Schiffs-u. Trop.-Hyg.*, 1926, 30 : 86

2. *Ibid.*, 1926, 30 : 732

3. We are indebted to Mrs. Elfreda L. Caldwell, of the International Health Board, for obtaining these worms for us.

Of the two methods commonly used for carrying out skin tests, the scratch and the intradermal, Brown¹ found that intradermal injection gave a positive reaction in all of 78 clinically positive hay fever cases, while the scratch method, with the use of dry powdered protein, was positive in only one-half the cases, but with fluid protein was positive in 82%. The fluid scratch method was therefore chosen for the present work, since it has the advantage of simplicity of performance without the severity of reaction which may follow the intradermal test in hypersusceptible patients.

The anterior surface of the forearm was washed carefully with alcohol. When dry, a drop of the solution to be tested and a control drop consisting of Coca's solution plus toluol were placed on the surface at least 4.0 cm. apart. The skin under each drop was then scarified by four transverse scratches with a sterile Hagedorn needle, different needles being used for each test in order to obviate any possibility of carrying over material from one site to another. The fluid was allowed to remain on the scarified area for five minutes and then was wiped off with a bit of cotton and the reaction was read. A second reading was made twenty minutes after scratching, and at first a reading was made after one hour, but this was subsequently discontinued because the maximum reaction was practically always reached by the end of twenty minutes.

Reactions were recorded as follows:—

++++	=	Wheal 2	cm. diam.—erythema at least 4.0 cm.
+++	=	" 1.5 "	" " " 3.0 "
++	=	" 1.0 "	" " " 2.0 "
+	=	" .5 "	" " " 1.0 "
?	=	Very small wheal or reddening, very slightly positive as compared with control	
—	=	No reaction	

In the condensed tables given in this report, however, + is used to indicate a positive reaction of any degree, since the data showed practically no difference in the distribution of severity of reactivity in infected and non-infected individuals and since, therefore, we are chiefly interested here in reactivity or non-reactivity *per se*. Controls were completely negative in all but two cases. In these a very small wheal and slight reddening occurred.

Although, when multiple tests were made, slight variations in reactivity were noted in some sensitive individuals, the correspondence was on the whole very good. In a few cases, however, individuals giving a negative reaction at one testing showed a positive reaction at another time and consequently were listed as positive. Since 11 of the 18 negative reactors to ascaris extract were tested only once, however, it is possible that our number of negative cases may be slightly higher than the actual number.

1. *Journ. Imm.*, 1922, 7 : 97

Ring tests for precipitins were made by layering 0.1 cc. of extract of varying dilutions on 0.1 cc. of the serum to be tested in a series of small tubes of 4 mm. bore. The tubes were examined after one hour's incubation in a water bath at 37° C. and again after three hours' refrigeration. The precipitin rings at the interphase of serum and antigen were recorded as++++, +++, ++, +, +? and —, according to the size of the ring present. As the maximum reaction occurred in most cases with undiluted antigen after one hour in the incubator and three hours in the ice box, this reading was used throughout the compilation of results. Serum-saline and antigen-saline controls were made in every case. These were uniformly negative.

Multiple precipitin tests (that is, tests on serum from the same patient at different times) showed marked correspondence. If there was any variation in the readings, the average reaction was used in tabulating results.

Diagnosis of intestinal parasitism is based on the results of the routine stool examinations made by the smear method by the laboratory staff of the hospital.

EXPERIMENTAL RESULTS

The work, with a few exceptions which will be noted later, was done on adult, male, Honduran natives at the Tela Railroad Company's Hospital. The majority of these men were of Spanish descent; a few were negroes.

A. — ASCARIS

With the ascaris extracts, 232 skin tests were made on 130 patients in the hospital, 62 of whom had a demonstrable ascaris infection at the time of testing. From the powdered human worm, 3 extracts were made, and from the pig ascaris, 5. Practically no difference could be detected between the human and the pig material in a series of 65 cases tested with both, for in 23 the human appeared to be slightly more reactive, in 19 it was somewhat less reactive, and in 23 it was identical with the pig extract. As Table I, A, page 229, shows, 105 of the 130 patients tested gave a positive reaction with ascaris extract although only 48 of these had a demonstrable ascaris infection, whereas 18 gave a negative reaction although 9 of these showed an ascaris infection. There seems to be, then, no correspondence between a positive skin reaction and the actual presence of ascaris infection.

In view of these facts, an attempt was made to determine whether or not skin tests were influenced by the presence of other parasitic infections, such as hookworm, trichuris, strongyloides, oxyuris, tapeworm and *E. histolytica* (Table I, B, page 229), by hookworm (Table I, C, page 229) or by trichuris (Table I, D, page 230), but it is apparent from the tables that they were not. In other words, the majority of the natives of Honduras give a positive skin test with ascaris extracts, regardless of whether they have or have not demonstrable ascaris or other parasitic infections.

The results of precipitin tests carried out in conjunction with the skin tests with ascaris extracts will be found in the protocol in Table II, page 230. Here, as in the skin tests, no difference in reactivity was detected between extracts from the human and the pig worms. One hundred and forty-six tests were made on sera from 90 patients. As has been said before, in the case of multiple tests, the average reaction was used in the tabulations. Of the 40 cases with actual ascaris infection at the time of testing, only 21 showed a positive precipitin test and of the 50 negative for ascaris, only 14 gave a negative precipitin test, results which show a very poor correspondence. Precipitin tests were run on sera from 90 of the 130 persons who were given skin tests, but there appears to be no correlation between the precipitin and the skin tests, as may be seen from an examination of Table II, B, page 230.

Attempts were made to find some relation between positive syphilitic reactions (Kahn test) and positive skin and precipitin reactions with ascaris extracts, but these were unsuccessful. Similarly, there appears to be no connection between the presence of malaria and ascaris skin reactions. In view of the fact, however, that serums¹ from 21 general paresis patients undergoing treatment with malaria at the Mayo Clinic all showed excellent precipitin reactions with ascaris extracts, it seemed interesting to ascertain whether there was any correlation between malarial infections and positive precipitin reactions. Accordingly, 50 serums were tested, of which 29 from patients showing malaria but no ascaris gave the following results: + + + +, 11; + + +, 4; + +, 2; +, 5; +?, 1; and -, 6, whereas 21 from patients negative both for malaria and ascaris gave the following: + + + +, 2; + + +, 2; + +, 4; +, 4; +?, 2; and -, 7. The relatively large number of + + + + reactions from the malarial cases may indicate some degree of correlation.

The results of a number of tests not listed in the foregoing descriptions are also of interest:

Case A. — A Spaniard, with a reliable history of ascaris infection several years before testing, but freedom from it for several years, gave a negative skin test.

Case B. — An American, also with a history of ascaris infection but uninfected at the time of testing, gave only a doubtful positive skin reaction, although a general reaction (coryza, lacrymation, etc.) always follows contact with the worm materials.

Case C. — One of the authors (W.H.T.) became accidentally infected with ascaris, and was successfully treated in January, 1921. In July, 1924, he was treated for skin sensitivity by Dr. B. H. Ransom with his experimental albumen fraction* and found negative. In March 1927, however, although he had remained uninfected and had not been in contact with ascaris in the interval, except for one day spent in Dr. Ransom's laboratory, exposure to the protein resulted in coryza and lacrymation. On April 5, 1927, a skin test showed a marked reaction—

1. We are indebted to Dr. T. B. Magath of the Mayo Clinic, Rochester, Minn., for these serums.

* Previously cited

a wheal and erythema with marked itchiness developed within 5 minutes, and within 20 minutes the wheal had become 2 cm. in diameter with an erythema 6 to 7 cm. in diameter. Subsequent tests (April 12, April 20, May 11 and July 13, 1927) gave similar results. Several precipitin tests made during these later tests were all negative, but "reagins" were demonstrated in his blood in the following manner: 0.1 cc. of his serum was injected intracutaneously into 2 sites on the left forearm of a negatively reacting individual. After 24 hours, one of these prepared sites was tested by the scratch method with an ascaris extract, and the other with the diluting fluid (Coca's solution and toluol), while unprepared sites on the right arm were likewise tested, with the following results:

			5 minutes	20 minutes
Prepared	site	— Ascaris extract . . .	++	++++
"	"	— Control solution . . .	+?	+
Unprepared	"	— Ascaris extract . . .	+?	—
"	"	— Control solution . . .	+?	+?

Tests made one week later at the prepared sites were negative with both the ascaris extract and the control solution.

Case D. — One of the authors (F. A. C.) with no history of infection, but in contact with ascaris since March, 1927, has given the following reactions:

	5 minutes	20 minutes
4/ 5/27	—	+?
4/20/27	—	+?
4/27/27	—	—
7/14/27	+	++
10/21/27	+	++++
1/17/28	+	++++

Here, as has been observed before in numerous cases, there has obviously been a gradually increasing sensitivity to the worm extracts, due to continual contact. No precipitins, however, have been demonstrated in the blood.

B. — HOOKWORM

Ninety-eight skin tests with hookworm extracts were made on 84 patients, the results of which are given in condensed form in Table III, A, page 231. Of 39 cases demonstrably infected with hookworm, 33 gave definite skin reactions with 2 doubtful and 4 negative reactions; whereas of 45 patients with no hookworm eggs in their stools, 5 gave negative reactions, 6 gave doubtful and 34 gave positive skin reactions. As was to be expected, positive skin reactions with hookworm extracts in patients not infected with hookworm could not be correlated with the presence of other intestinal parasites (Table III, B, page 231).

Because of lack of material, only a few precipitin tests were carried out with hookworm extracts and, as these showed nothing of particular interest, the data need not be considered here.

Very little difference was found between the extracts prepared by the two methods previously described, although that prepared by drying without the preliminary addition of ether may have been a trifle more reactive.

C. — TRICHURIS

Seventy skin tests with trichuris extracts were made on 64 patients, 28 of whom had demonstrable infections with *Trichuris trichiura* at the time. From an examination of Table IV, A, page 231, it may be seen that on the whole there were fewer positive reactions with this extract than with either the ascaris or hookworm solutions, but no better correspondence between the skin tests and the presence or absence of infection. Furthermore, concomitant parasitic infections seemed to have no influence on skin reactivity to the trichuris extract (Table IV, B, page 232).

No precipitin tests were made, because of lack of material.

DISCUSSION

The outstanding feature of the present study is the fact that there is practically no correlation between present infections with helminths and cutaneous sensitivity, as tested by the immediate reaction with the scratch method. In those cases where the individuals were negative for infection but positive for skin sensitivity, the objection might be raised that infection was present but of such low grade that diagnosis was missed by the smear method¹ or that infection consisted of only immature stages. On the other hand, however, a number of cases positive for helminths did not show skin hypersensitiveness, but in such cases there may be an error due to the use of the scratch method.

To explain those cases of skin hypersensitiveness where there is no infection with the specific parasite, most authors assume that there has been a past infection or past contact, as in the case of zoologists and veterinarians who work with the worms. These are the conclusions reached by Fülleborn in his recent studies.²

Whether or not infection with helminths always results in a positive reaction is difficult to decide definitely. Ransom, Harrison and Couch³ mention the fact that several non-reactors were found who had been infected in childhood. Our cases A and B had histories of ascaris infections but gave no reactions. In the case of one of the authors (W. H. T.) no reaction was obtained three and a half years after infection, although he later gave positive tests. Furthermore, there are a number of cases recorded in the present work, which were positive for worms but did not react.

The great difficulty in evaluating these data is that all of these tests were made by the scratch method. Brown,⁴ working with various proteins, found

1. In a recent paper on regularity of egg production, however, Brown² calculates that one of his cases was infected with only 2 ascarids. If his calculations are correct and egg production can be studied by the smear method in a case with only 2 worms present, it seems likely that very few positive cases are missed

2. *Journ. Parasit.*, 1927, 14 : 110

3. *Loc. cit.*

4. *Journ. Imm.*, 1922 : 7 : 97

in comparing the scratch method with the intradermal injection method that the former gave only 80% positives in the case of known positives with the injection method. Therefore some of these negative results may be due to the use of the scratch method.

In this connection it is interesting to note that in the case of both hookworm and ascaris, we found approximately 80% positives. There is the possibility, then, that these two infections are almost universal at some time in life in the class of natives studied and that these patients would have been practically 100% positive had they been tested by the injection method.

A further explanation of these negative results may be that some individuals lose their skin reactivity under the influence of a heavy infection with the specific parasite. This is borne out by the fact that, as noted by Baldwin¹ in the therapeusis of hay fever by the injection of the specific protein, although some persons retain their skin sensitivity after clinical cures, others lose it. Also, after surgical removal of echinococcus cysts with the consequent possible absorption of helminth protein, Dew, Kellaway and Williams² frequently found a great variation in the type of response to skin tests.

Brunner³ has just published the results of a study on intradermal tests with parasitic (chiefly ascaris) extracts, using the injection method. His results are somewhat similar to ours but his conclusions are radically different in that he believes the method to be a valuable aid in the clinical diagnosis of helminthiasis.

Working with 20 cases positive for helminths (1 ascaris, 6 trichuris, 3 oxyuris, 9 hookworm, 1 trichinella), he obtained 1 + and 19 +++ skin reactions with ascaris extracts in the infected cases; 30 - but 16 +++, 9 ++, and 4 + among those with negative stools.

It is to be noted that there is only one case in this series infected with ascaris. The author explains the positive results with stools positive for other helminths, however, by assuming a group reaction between the intestinal nematodes. He suggests several possibilities as to the reason for positive reactions with negative stools, concluding that the most plausible is past infection. Since, however, 50% of those with negative stools reacted to the skin test and since information concerning their case histories is very meager, it is difficult to evaluate these data. The studies on reactions in children, which were designed to elucidate this point, are not very convincing since the tables show that 4 out of 7 giving +++ reactions had negative stools and moreover 86 of 88 giving + and ++ reactions had negative stools. Brunner does not consider the + and ++ reactions of diagnostic value, but, considering individual variation from time to time, it seems to the present authors that they should be taken into account.

1. *Journ. Imm.*, 1927, 13 : 345

2. *Loc. cit.*

3. *Journ. Imm.*, 1928, 15 : 83

It should be remembered that results similar to Brunner's—failure of very young children to react—may likewise be explained on the basis of an atopic mechanism, wherein sensitivity can only develop later in life. In the absence of well-controlled, extensive experiments, this possibility should be kept in mind.

Negative reactions with positive stools, found in a certain percentage of our cases but not at all by Brunner, may be due to the fact that he used the intradermal test, a possibility discussed above.

Certain phenomena characteristic of atopic hypersensitiveness are noticed in the results of the present investigation of hypersensitiveness to worm proteins. In the first place, there is no correlation between the presence of precipitins in the blood and skin reactivity. Secondly, reagins can be demonstrated in the blood of a sensitive individual by passive transfer of his serum to a normal individual.

Some work both in this paper and in others suggests that Coca's distinction between sensitivity to worm extracts and hay fever sensitivity, i.e., that any person is capable of forming the reagins in helminth infections whereas an hereditary factor is necessary in cases of hay fever, is valid but that further work is desirable.

SUMMARY

1. Hypersensitiveness to ascaris protein was manifest in 80% of 130 Honduran patients tested by the scratch method, as shown by wheal formation and erythema within 20 minutes after testing.

2. This sensitiveness could not be correlated with presence of ascaris infection, nor with the presence of other helminths. The test, therefore, has no diagnostic significance.

3. Precipitin tests with ascaris extracts, positive in 61% of the 90 cases studied, could not be correlated with presence of ascaris in the stools nor with the presence of other infections.

4. No relation between skin reactivity and presence of precipitins in the blood could be demonstrated.

5. Wheal formation and erythema followed the scratch test with hookworm extracts in 80% of 84 patients tested, but no correlation existed between the reactions and presence or absence of infection.

6. Wheal formation and erythema followed the scratch test with trichuris extracts in 25% of 64 cases studied. Here again, no relation was found between positive tests and presence of infection.

TABLE I

RESULTS OF SKIN TESTS WITH ASCARIS EXTRACTS

A. Correlation of Tests with Ascaris Infections

Stool Examination	Result of Tests			Total
	+	?	—	
A +	48	5	9	62
A —	57	2	9	68
Total . .	105	7	18	130

B. Correlation of Tests with Ascaris and Other Parasitic Infections

Stool Examination		Result of Tests			Total
		+	?	—	
A +	O* +	38	4	4	46
A +	O —	10	1	5	16
A —	O +	37	1	8	46
A —	O —	20	1	1	22
Total . .		105	7	18	130

O* = Other intestinal parasites, viz., strongyloides, oxyuris, tapeworm, *E. histolytica*, hookworm or trichuris

C. Correlation of Tests with Ascaris and Hookworm Infections

Stool Examination		Result of Tests			Total
		+	?	—	
A +	H +	26	3	3	32
A +	H —	22	2	6	30
A —	H +	22	2	3	27
A —	H —	35	1	6	41
Total . .		105	8	18	130

D. Correlation of Tests with Ascaris and Trichuris Infections

Stool Examination		Result of Tests			Total
		+	?	—	
A +	T +	29	3	2	36
A +	T —	19	2	7	26
A —	T +	18	0	5	23
A —	T —	39	2	3	45
Total . .		105	7	17	130

TABLE II

A. Results of Precipitin Tests with Ascaris Extracts

Stool Examination		Result of Tests			Total
		+	?	—	
A +	O*+	13	3	9	25
A +	O —	8	1	6	15
A —	O +	23	3	8	34
A —	O —	9	1	6	16
Total . .		53	8	29	90

O* = Same as in Table 1

B. Correlation of Ascaris Skin and Precipitin Tests

Stool Examination	Skin Tests	Precipitin Tests			Total
		+	?	—	
A +	+	13	3	11	27
	?	3	1	1	5
	—	5	0	3	8
A —	+	26	2	11	39
	?	1	1	0	2
	—	5	1	3	9
Total		53	8	29	90

TABLE III

RESULTS OF SKIN TESTS WITH HOOKWORM EXTRACTS

A. Correlation of Tests with Hookworm Infections

Stool Examination	Result of Tests			Total
	+	?	—	
H +	33	2	4	39
H -	34	6	5	45
Total . .	67	8	9	84

B. Correlation of Tests with Hookworm and Other Parasitic Infections

Stool Examination		Result of Tests			Total
		+	?	—	
H +	O* +	25	1	0	26
H +	O -	8	1	4	13
H -	O +	23	4	2	29
H -	O -	11	2	3	16
Total . .		67	8	9	84

O* = Same as in Table I

TABLE IV

RESULTS OF SKIN TESTS WITH TRICHURIS EXTRACTS

A. Correlation of Tests with Trichuris Infections

Stool Examination	Result of Tests			Total
	+	?	—	
T +	7	2	18	27
T -	7	6	24	37
Total . .	14	8	42	64

B. Correlation of Tests with Trichuris and Other Parasitic Infections

Stool Examination		Result of Tests			Total
		+	?	—	
T +	O* ₊	6	1	15	22
T +	O _—	1	1	3	5
T _—	O ₊	4	4	17	25
T _—	O _—	3	2	7	12
Total . .		14	8	42	64

O* = Same as in Table I

A PRECIPITIN TEST IN MALARIA (SECOND REPORT)¹

WILLIAM H. TALIAFERRO, PH.D. AND LUCY GRAVES TALIAFERRO, SC.D.

In the first paper of this series² the more important results of our first year's work at Tela, Honduras, were reported. Briefly, it may be stated that in attempting to devise a precipitin test for malaria, 1,605 precipitin tests were performed with 37 different antigens on serums from 535 persons. The most successful antigen was prepared from a placenta infected with *Plasmodium falciparum* and was tested against serums from 86 persons. Of these, 54 were found infected with *Plasmodium vivax* or *P. falciparum* in thick or thin films and gave 45 positive precipitin tests (10₊₊₊, 21₊₊, 14₊), 2 doubtful, and 7 negative. The other 32 were negative for malaria in thick films, and gave 6 positive tests (2₊₊, 4₊), one doubtful, and 25 negative.

The present paper records a series of 1,438 precipitin tests carried out a year later at the same place with 75 different antigens³ on the serums of 298 persons, almost all of whom were ward patients in the Tela hospital. They confirm our earlier results, and extend our knowledge of suitable antigens. As in our previous experience, most of the antigens were unsatisfactory and will not be described in detail. Of the remainder, we will describe:

- (1) Further work on the antigen that gave promise the preceding year
- (2) The best antigens prepared from dried concentrates of an infected placenta

1. This work has been liberally aided by a grant from the International Health Board. We again wish to thank Dr. W. E. Deeks and the United Fruit Company, through whose courtesy the present tests were made at the Tela Railroad Company's hospital in Tela, Honduras. We are also greatly indebted to Dr. R. B. Nutter, Superintendent of the Tela Hospital; and to his staff, in particular to Dr. E. J. Whitaker and Mr. J. C. McDaniel; and to Dr. Frances Coventry, of the University of Chicago.

2. *Fifteenth An. Rept.*, Med. Dept., United Fruit Co., 1926, p. 48; also *Journ. Prev. Med.*, 1927, 1 : 343

3. The term antigen will be used throughout this paper to designate the material used in *in vitro* tests, thus deviating from its strict usage to connote substances stimulating the production of antibodies within the animal body.

- (3) Attempts to prepare antigens from an infected spleen and from cultures of infected blood

Only infected organs were utilized in these experiments because our initial work clearly indicated that antigens, to be reactive, must contain large amounts of malarial protein.

In our first communication we noted the results on specific complement fixation in malaria by de Blasi,⁴ Gasbarrini,⁵ Thomson,⁶ and Horowitz-Wlassowa⁷; and on a precipitin test by Ziemann⁸ and Pewny⁹. No further work on precipitins in malaria has come to our notice, but two subsequent series of results on complement fixation have appeared.

Kingsbury¹⁰ notes that, although the complement fixation tests in such disorders as tuberculosis, hydatid disease and schistosomiasis are not as reliable as the Wassermann reaction in syphilis, some success has been attained by reducing the amount of complement to be fixed and by employing a suitable antigen—i. e., one of high sensitivity and specificity and low anti-complementary power. Of 11 antigens tried (8 from spleen, liver, heart, brain and blood of *P. falciparum* infections and 3 from blood of *P. vivax* infections), the most satisfactory were from saline emulsions of washed and hemolysed infected blood. The latter gave the following results: *P. falciparum* antigen tested, first, against 25 cases of *P. falciparum* gave 48 per cent positive, and later, against 12 cases of tertian, gave 50 per cent positive. Two series with *P. vivax* antigen, the first with 16 *P. falciparum* cases and the second with 6 *P. vivax* cases, gave 31 and 67 per cent positives, respectively.

One of the most interesting methods of preparing an antigen for the diagnosis of a parasitic infection was devised by Fairley¹¹ in his work on *Schistosoma*. He found that absolute alcohol extracts of the "livers" of infected snails yielded a highly specific antigen. Manson-Bahr,¹² following his method, has attempted to obtain an antigen from the oöcysts of plasmodia in the stomachs of mosquitoes. In spite of the difficulty of obtaining material, he succeeded in making alcoholic extracts of the stomachs of 26 infected *Anopheles maculipennis* and of 24 *Culex* infected with bird malaria, but was unable to find any evidence of complement fixation. He believes, however, that success can be attained with a stronger antigen—at least 100 stomachs to 1.0 cc. of absolute alcohol. To the present authors it seems that he could have secured a stronger antigen had he used an aqueous rather than an alcoholic menstruum for extracting the infected stomachs.

4. *Ann. d'Ig. Sper.*, 1907, 17 : 677, cited in *Centralbl. f. Bakt. Ref.*, 42 : 160

5. *Ztschr. Immunitätsf., Orig.*, 1913, 20 : 178

6. *Brit. Med. Journ.*, 1918, 2 : 628; also, especially, *Proc. Roy. Soc. Med.*, 1919, 12 : 39

7. *Ztschr. Immunitätsf.*, 1924, 40 : 268

8. *Handb. d. Tropenkrankh.*, 1924, 3 : 592

9. *Wien. klin. Wchschr.*, 1918, 31 : 205

10. *Trans. Roy. Soc. Trop. Med. and Hyg.*, 1927, 20 : 359

11. *Journ. Roy. Army Med. Corps*, 1919, 32 : 243

12. *Trans. Roy. Soc. Trop. Med. and Hyg.*, 1927, 21 : 63

METHODS

We have already given a detailed account of our method of carrying out the precipitin tests. It will suffice here to note that .15cc. of the antiserum or patient's serum was pipetted into a small tube with a capacity of about 0.65 cc. and an equal quantity of antigen layered on top. Each test consisted of four tubes: antiserum and undiluted antigen, antiserum and a 1 to 5 dilution of antigen in saline, antiserum and saline (control), and antigen and saline (control). Positive tests consisted of a precipitate at the interphase of the antiserum and antigen, and were classified as +++, ++, and +. Although final readings were made after the tubes had been incubated at 37° C for 1 hour and kept in the ice box for from 6 to 9 hours, quite often the same results were obtained simply after the incubation at 37° C.

PLACENTAL ANTIGENS

The most promising antigen in our last year's work was made from a placenta, heavily infected with *P. falciparum*, by mincing in a meat-chopper, extracting with ether for 18 days, digesting the ether insoluble portion for a week or more in Coca's extractive (NaCl 0.7 per cent, NaHCO₃ 0.05 per cent, and phenol 0.4 per cent)¹³, and using the clear filtrate as antigen. This procedure we used as a starting point in our present work, and at the same time made various modifications in the hope of finding an even more potent antigen.

Three infected placentas became available this year, and of these, one was particularly useful, so that we will describe the experiments carried out with it in detail, and simply include the results obtained with the other two where the conditions were similar. This placenta, obtained immediately after delivery (5-7-27), was heavily infected with schizonts of *P. falciparum* at their maximum size, i. e., just prior to the liberation of merozoites. It was divided into several parts so that a wide variety of methods might be tried out, and these will be considered under several subheads. Of particular interest are those antigens made from dried placental products because they may possibly be kept over long periods.

I. MINCED PLACENTAL TISSUE

The placenta, after removal of the membrane and larger blood vessels, was ground in a meat-chopper. It was very surprising to find that a smear from the minced placenta showed more schizonts than the original blood smear from the placenta, which probably means that the parasites adhere so closely to the

13. This formula for Coca's fluid has been used because it was successfully employed by Wagener in her work on skin reactions in *Leishmania* (*Univ. Calif. Pub. Zool.*, 1923, 20 : 477) and on a precipitin test in experimental amoebiasis of cats (*Ibid.*, 1924, 26 : 15), although it contains less sodium bicarbonate than the percentage (0.25) given by Coca in his original paper (*Journ. Immunol.*, 1922, 7 : 163).

walls of the smaller vessels that they are not dislodged by the ordinary technique of making placental smears. This minced placenta, — containing a concentration of parasites as illustrated in Figure 1 page 240, was treated in various ways, as follows:

a. Coca-ether Antigen. — 50 grams of minced placenta were mixed with an equal quantity of ether. Three days later, 50 cc. of Coca's solution were added without removing the ether. (This represents two modifications of the previous year's method which were resorted to with the hope of increasing the potency of the antigen. In the first place, the ether was not removed when the Coca's was added because the preliminary extraction with ether had proved helpful, and therefore, it seemed desirable to have an excess present during the solution of the proteins in Coca's solution. In the second place, less Coca's solution, in proportion to weight of placenta, was added). Four days later, and as needed thereafter, the aqueous stratum was pipetted off, filtered through hard filter paper and used as antigen. The first tests run were disappointingly inactive. For example, tests run almost daily during 8 to 20 days' digestion in Coca's solution against serums from:

	+++	++	+	+?	-
44 infected persons gave	2	4	12	3	23
44 non-infected persons gave		3	4	3	34

At first we thought the antigen had not digested long enough to become reactive, but we finally traced the difficulty to a question of hydrogen ion concentration.

We had assumed this antigen to be alkaline, because Coca's solution is slightly alkaline, and in our previous year's work this type of antigen was about pH 7.8, but when we did test it, we were surprised to find it about pH 6.0. (We hope in the future to ascertain why our antigens sometimes remain alkaline and sometimes become acid.) Consequently, a series of tests was immediately run on 8 serums with the pH of the antigen varying over a wide range, with the result that pH 7.8 seemed most efficient. Subsequently, whenever this antigen was used, the required amount was pipetted off from the stock bottle, filtered and adjusted to pH 7.8 with n/20 NaOH before use. Phenol red was used as an indicator throughout.

In Table 1, page 244, under the Coca-ether antigen, are given the results obtained on 64 serums with this antigen and 2 others similarly prepared from 2 other infected placentas. Only one reading is given for each patient, although 41 of the patients had multiple tests as follows: 19 had 2 tests, 7 had 3, 8 had 4, 4 had 5, 1 had 6, and 2 had 7. In most cases, the multiple tests showed a good correspondence. When they did not, we have given the average result. Thus, if one test was + and the other— we have called it +?; if one was +++ and three were +, we have called it ++, etc. The results, briefly summarized, are as follows:

	+++	++	+	+?	-
Serums from 32 infected persons gave	4	11	15	1	1
Serums from 32 non-infected persons gave			1	4	27

This is a remarkable correspondence and is quite different from the results obtained with these antigens in the acid condition. In fact, we were disappointed at the scarcity of the positives from the persons negative in the thick film, because some of them no doubt had the latent disease.

From the data already given, it may be seen that in the two years' work, antigens from four infected placentas have been prepared by extraction with ether, digestion in Coca's solution and use of the filtrate at a pH of 7.8. It is interesting to note that all of them have proved efficient, as may be seen when the precipitin tests obtained with each of these antigens are considered separately, as follows:

A. SERUMS FROM INFECTED PATIENTS

Source of Antigen	+++	++	+	+?	-
Placenta reported in first year's work	10	21	14	2	7
Placenta delivered 5-7-27	2	10	9	1	2
Placenta delivered 3-9-27		1	3	0	1
Composite antigen made 6-3-27 from a mixture of the two preceding ones	2	3	1	2	4

B. SERUMS FROM NON-INFECTED PATIENTS

Placenta reported in first year's work	2	4	1	25
Placenta delivered 5-7-27			2	11
Placenta delivered 3-9-27			1	13
Composite antigen made 6-3-27 from a mixture of the two preceding ones			2	15

Undoubtedly, however, we shall find in future work that some placentas are better sources of antigen than others, as the amount of contained malarial protein must vary to a considerable extent.

A further examination of the results obtained with the Coca-ether antigens in Table 1 leads to the following conclusions:

1. Provided parasites are found in the thick film, there is very little correspondence between the number of parasites and the intensity of the precipitin reaction. Thus, in cases 2, 7, 11, 20, 21, 24, 27, 31 and 32, where only 1 or 2 parasites were found, the precipitin results show 1+++ , 2++ , 4+ , 1+? and 1- , which differ only slightly from the percentages of these reactions in the entire series.

2. Intestinal parasites apparently do not influence the reaction.

3. It is unfortunate that there are not more positive Kahn tests in the series which were negative for malaria. It is interesting to note, however, that the one person positive for malaria who gave a negative precipitin test (Case 32) gave a ++++ Kahn. Furthermore, among the cases negative for malaria, Case 37 gave a ++++ Kahn and a +? malarial precipitin test. As far as it goes, this indicates that our present precipitin test for malaria is not complicated by the presence of syphilis.

4. In the series, 10 cases were infected with *P. vivax* alone. As far as can be seen, they reacted as well as did those infected with *P. falciparum*. This is of interest because the antigen was prepared from *P. falciparum* material.

5. It is almost impossible to draw many conclusions in regard to the effect of treatment on the precipitin test. The data appertain exclusively to that given in the hospital, but of necessity can not include frequent treatments given before entry. Nevertheless, it is evident that the treatments, as indicated, did not inhibit the precipitin reaction. Among the so-called negative cases recorded in Table 1, Number 33 had been infected with *P. falciparum* the previous year, he had received several intensive treatments, and at the time of the tests showed no parasites in his blood, but his serum gave a + reaction. On the other hand, Number 55 showed *P. falciparum* in thick films on 5-21-27, but was negative on 5-30-27 when the precipitin test was done and gave a negative reaction.

6. It would be of considerable practical importance if a serum would retain its reactivity for 24 hours or longer. Multiple tests were accordingly carried out on 11 serums. Although the results, as shown in Table 2, page 246, are somewhat variable, they indicate that serum after 24 hours gives approximately as strong a reaction as fresh serum.

b. *Minced Placenta Treated with Quinine.*—50 gms. of minced placenta were mixed with distilled water, quinine hydrochloride and thymol according to the proportions used by Horowitz-Wlassowa in his complement fixation studies (placenta 160 gms., distilled water 100 cc., quinine hydrochloride .1 gm., and a few crystals of thymol as a preservative). This antigen, as in our work of 1926, was entirely unsatisfactory. Its pH was about 7.8 and it was tried with 42 serums:

	+++	++	+	+ [?]	-
Serums from 21 infected persons gave .		6	6	5	4
Serums from 21 non-infected persons gave		1	4	4	12

Not only are these results far less satisfactory than those with the Coca-ether antigen, but the antigen itself tended to become cloudy during the test and to give a diffuse ring of precipitate at the interphase of serum and antigen.

c. *Other Antigens from Freshly-Minced Placenta.* Three 50 gm. lots of minced placenta were treated with n/20 NaOH antiformin and n/20 HCl, respectively, and before use the supernatants were adjusted to pH 7.8. None of these was satisfactory.

d. *Dried Minced Placenta.*—50 gms. of the tissue were dried *in vacuo* over calcium chloride and pulverized at intervals in an agate mortar. Some of this, on two separate occasions, was treated with Coca's solution (.05 gm. to 5 cc. Coca's) and kept under toluol. The supernatant, as an antigen, when its pH was adjusted to 7.8, had a tendency to become cloudy and to react with serums from both infected and negative persons. Thus:

	+++	++	+	+ [?]	-
Serums from 29 infected persons gave .	3	15	3	4	4
Serums from 24 non-infected persons gave		5	7	5	7

The cloudiness of this antigen may have been connected with the fact that the material became slightly contaminated during the process of drying.

In view of the promising results obtained with the concentrated parasites treated with $n/20$ HCl, to be described later, we treated .05 gm. of this powder with 1.5 cc. $n/20$ HCl for 8 hours, but the supernatant, after adjustment of its pH, was very inert. With eleven serums from infected persons, it gave 1 + and 10- readings, and with 5 serums from negative persons, 5- readings.

II. CONCENTRATION OF PLACENTAL PARASITES AND PREPARATION OF ANTIGENS FROM DRIED PLACENTAL BLOOD

After the preceding antigens had been made, about 43 cc. of liquid were left, which consisted chiefly of blood and isolated tissue cells. From this we were anxious to get as pure a suspension of the parasites as possible. Fortunately, the size of the schizonts allowed us to concentrate them by the method of Bass and Johns¹⁴ who, working with cultures, noted that after centrifugation the large plasmodia-infected red cells will layer on the top of uninfected red cells or those containing small parasites.

a. First Concentrate.— This material was accordingly placed in a 50 cc. centrifuge tube and centrifuged for 30 minutes at 2,800 revolutions per minute. On top of the red cells, a chocolate-colored material of approximately 13 cc., which contained enormous numbers of parasites, was pipetted off, mixed with an equal quantity of 85% saline and re-concentrated by again centrifuging. Figure 2, page 240, shows the approximate number of parasites per microscopic field obtained. Subsequently, this material was dried *in vacuo* over calcium chloride, and during the process was frequently ground in an agate mortar until a fine powder was procured.

Antigens prepared from this dried concentrate are of particular interest because such material could probably be preserved for long periods without losing its reactivity. Our most extensive experiments were carried out with an antigen prepared by digesting .05 gm. of the dried powder 10 to 20 hours in 1.5 or 2.0 cc. of $n/20$ HCl made up in .85 percent NaCl and using the supernatant after adjustment of its pH (7.6 to 7.8) with $n/20$ and $n/100$ Na OH in .85 percent NaCl. In preparing this antigen, it is very essential not to allow the acid to act on the powder over 20 hours, because in our experience a longer treatment results in a cloudy antigen and causes a heavy flocculent precipitate in all tubes. Hence, the requisite amount for each day has to be made fresh. Of the 64 cases in Table 1, 54 were tested with this antigen (dried-acid), and, in addition, 24 other cases were tested¹⁵. The summary of the results from all 78 cases are given in Table 3, page 246. An examination of this table shows that, omitting the

14. *Amer. Journ. Trop. Dis. and Prev. Med.*, 1915, 3 : 298. The authors here wish to express their thanks to Dr. C. C. Bass for many helpful suggestions concerning the use of methods for both cultivating and concentrating the plasmodia.

15. The data for only 54 of these are given *in extenso* in Table 1 (p. 244), but as they constitute a fair sample, it seemed unnecessary to do more than summarize the complete data in Table 3 (p. 246), q.v.

doubtful readings, 34 infected persons gave 29 positives and 5 negatives, and 41 negative persons gave 9 positives and 32 negatives. Furthermore, the results obtained with this antigen compare very favorably with the Coca-ether antigen (see Table 1 page 244, for 54 cases; and for a correlation of the same cases, see Table 4 page 247).

From this dried concentrate we also made several lots of antigen by digesting .05 gm. in 2.0 cc. of Coca's solution. In Table 1, page 244, the results of tests with 18 serums are given (see dried Coca-antigen). In addition, 14 other serums were tested. Briefly, the 32 serums gave the following:

	+++	++	+	+?	-
23 infected persons gave	12	9	1	1	-
9 non-infected persons gave		1	4	-	4

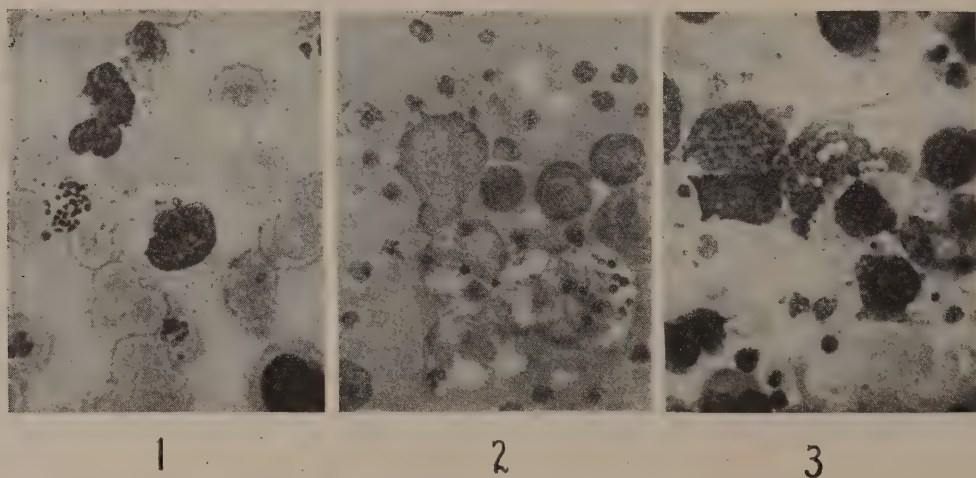
Although one might be tempted to consider this antigen as unsatisfactory because it reacted with 5 of the 9 negative serums, it must be remembered that some of the negative cases might very probably have been latent cases, and besides, its reactions with positive serums were, in general, much stronger than with negative. We feel that this method of preparing antigen justifies more extended work in the future.

b. Further Concentrations. — The red cells left after the top 13 cc. of infected cells had been removed contained so many parasites, comparatively speaking, that several more centrifugations were carried out, and the top layer each time was removed and dried as above. As might be expected, since each subsequent layer contained fewer and fewer parasites, each successive concentrate was less suitable as antigen, when treated as before with acid or Coca's. Thus, the second, concentrated layer (Fig. 3, page 240) when treated with acid was tested against the serums of 7 infected persons giving 5+, 1+? and 1-, and against the serums of 3 negative persons giving 1++ and 2-. Furthermore, numerous other tests had to be discarded because the antigen became cloudy during the tests. When made up with Coca's this antigen with serums from 7 infected persons gave 3++, 1+ and 1- and from 3 negative persons 3-, which is a decidedly better correspondence.

A third and fourth concentration of the parasites, as they gave very similar results, may be considered together. Since these layers contained a fairly large proportion of uninfected red cells and red cells with very small parasites, they were treated with anti-human red-cell rabbit serum and guinea-pig complement. After hemolysis of the red cells, the parasites were washed twice in .85 percent saline to free them of foreign serum, and the following results were obtained when first, acid, and second, Coca's (methods previously described) were used:

Antigen + acid:	+++	++	+	+?	-
Serums from 28 infected persons gave. . .	2	3	7	2	14
Serums from 14 non-infected persons gave.	2		2	5	5
Antigen + Coca's:					
Serums from 16 infected persons gave. . .	4	5	5	1	1
Serums from 13 non-infected persons gave.	2	1	8	1	3

From these data it may be seen that the third and fourth concentrates showed no correlation between reactivity and infection. Furthermore, they showed a tendency to become cloudy. Microscopic examination of this material showed that the repeated manipulations had ruptured most of the cells containing parasites, leaving only pigment, and that although the red cells were hemolyzed, there remained a great many tissue cells which probably accounted for the unsatisfactory results.



SMEARS OF THE INFECTED PLACENTA DELIVERED 5-7-27 (X900)

FIG. 1. Minced placenta, showing the size and number of schizonts. This material was used for the "Coca ether" antigen (see Table 1, page 244).

FIG. 2. The first concentration of plasmodia from the blood squeezed out of the minced organ, showing many large schizonts. This material was used for "dried-acid" (see Table 3, page 246, and "dried-Coca"—see text) antigens.

FIG. 3. A second concentration of plasmodia from the blood after the material shown in Figure 2 was removed. "Dried-acid" and "dried-Coca" antigens prepared from this material, although reactive, were not as satisfactory as those prepared from the material shown in Figure 2.

c. *Supernatants*.—As it was quite evident that, at each successive concentration, more and more parasites disintegrated, we saved the supernatant fluid in each case for use as antigen, on the supposition that it might contain a large amount of malarial protein, but in all cases it was either non-reactive or cloudy.

ANTIGENS FROM AN INFECTED SPLEEN

The spleen from a fatal case of malignant tertian was removed 21½ hours after death. It was very little enlarged, but contained many malarial organisms. It was minced in a meat-chopper and the following antigens were prepared:

a. Coca-ether Antigen.—About equal quantities of minced spleen and Coca's fluid were mixed and an excess of ether was added. A week later and several times thereafter the aqueous portion was filtered through hard filter paper, adjusted to pH of 7.8, and tested. We were, however, never able to obtain uniform results—some days its reactivity corresponded fairly well with infection and non-infection; at other times, it reacted indiscriminately. For example:

After 6 days extraction:	+++	++	+	+?	—
Serums from 6 infected persons gave . . .	2	1	2		1
Serums from 4 non-infected persons gave			1		3
After 9 days extraction:					
Serums from 5 infected persons gave . . .	5				
Serums from 4 non-infected persons gave .	3	1			

Furthermore, sometimes a cloudy precipitate formed in all tubes. It may well be that with a careful study of the most suitable pH an efficient antigen could be prepared from this source.

b. Concentrates.—The malarial organisms were concentrated from the blood of this organ, as has been described in detail for the placenta, but as the parasites were smaller, they did not concentrate as well. Then they were dried over sulphuric acid and pulverized. 1.5 gm. of this powder were treated overnight with 2cc. n/20 HCl and, after centrifuging, the supernatant was adjusted to pH 7.6. When run against the serums of 7 infected persons, it gave 1++, 5+ and 1+?, and against 3 negative persons 2+? and 1—. These preliminary results were promising, but lack of time prevented a longer series. We found that, just as in the case of the concentrated parasites from the placenta, if the hydrochloric acid were allowed to stand on the powder more than a day, the resulting antigen gave a heavy flocculent precipitate in all cases.

c. Ground spleen.—The supernatant from freshly ground spleen after digestion in acid overnight and adjustment of its pH was unsatisfactory. Similarly, all attempts to use n/20 sodium hydroxide as an extractive, with either freshly ground or dried products of the spleen failed, since the antigens were always cloudy.

d. Supernatant.—The supernatant washings obtained while concentrating organisms from the spleen were entirely unsatisfactory. These results are in accord with similar experiments with the placenta.

ANTIGENS FROM CULTURES OF PERIPHERAL BLOOD

Our first year's work indicated that infected blood might be as good as placenta as a source of antigen, but our recent work did not bear this out. We used 19 blood samples from different patients, of which 14 were infected with *P. falciparum*, 2 with *P. vivax* and 3 with both. In each case, about 20 cc. of blood were drawn into citrate or heparin or defibrinated, distributed into about 20 tubes and cultured according to Bass and John's technique¹⁶. When the asexual forms had reached their maximum size, the cultures were pooled, and the parasites concentrated, as described above. Approximately 0.3 cc. of a very heavy suspension of red cells infected with very large malarial organisms were obtained from each 20cc. sample. These were sometimes used directly and sometimes treated with distilled water or antihuman-red-cell rabbit serum to remove as much foreign material as possible. Then, various antigens were prepared by (1) extracting with Coca's with or without a preliminary treatment with ether, (2) dissolving with "antiformin" or sodium hydroxide and neutralizing with hydrochloric acid before use, or (3) drying and extracting in physiological saline or n/20 hydrochloric acid and neutralizing before use. Most of these were practically non-reactive; a few gave a cloudy precipitate with all serums; and only a few approached, but did not quite equal, the reactivity of antigens from the same source prepared last year. Even if the results with infected blood were as good as with infected placentas, the drawback of obtaining enough malarial protein would still remain, for it is easy to see from our experience in concentrating the parasites from placental tissue that a placenta yields more parasites than could conceivably be obtained from an enormous number of cultures.

DISCUSSION

The present work corroborates our previous conclusions that precipitins can be demonstrated in serums from malarial patients with an antigen prepared from an infected placenta by grinding, treating with ether and extracting the ether insoluble portion in Coca's solution (ether — Coca antigen). Furthermore, it establishes the fact that such antigens may become acid—in which case they have to be adjusted to a pH of approximately 7.8 before they are reactive. Moreover, the fresh tissue can be preserved in ether at least as long as one month before extracting with Coca's solution and still be reactive. (No tests were made longer than this). And in one case, an antigen has been found reactive after digesting 70 days in Coca's. This year we also attempted to bring some of this antigen from Tela to Chicago to test it against serums from paretics with induced malaria¹⁷, but the results so far have been very variable and need further

16. *Journ. Exp. Med.*, 1912, 16 : 567

17. Although these serums have been obtained from many sources, we are indebted to Dr. T. B. Magath of the Mayo Clinic for supplying most of them.

work to analyze the factors underlying the variability. From the foregoing, it is obvious that if the placental material could be preserved indefinitely at any stage in its preparation, its use as antigen would be greatly facilitated in any large series of tests, and it could then be collected in one locality for use elsewhere.

Accordingly, a new method of preparation has been devised which offers promising possibilities. If the placenta be passed when the schizonts of *P. falciparum* are full grown, the organisms may be concentrated by Bass and John's centrifugation method and then dried and ground. The resulting powder can be easily kept. Thereafter, it yields an efficient antigen by digesting not more than 20 hours in $n/20$ HCl and adjusting the supernatant to pH 7.8 just before use (dried-acid antigen). Preliminary results also indicate that it gives satisfactory results when digested in Coca's solution under toluol (dried Coca antigen).

One difficulty in this work is the comparative scarcity of malarial localizations in the placenta. This occurs only in a small percentage of infected mothers. Nevertheless, our work on the concentration of the parasites indicates that an enormous quantity of malarial protein sufficient for a large number of tests can be obtained from one infected placenta. With the methods of preservation just noted, therefore, it may be possible to collect materials in one locality for use in other parts of the world.

SUMMARY

A second series of 1,438 precipitin tests on the sera of 298 persons with 75 different malarial antigens indicates:

1. The most satisfactory type of antigen used in our first work, i.e., that prepared from placentas heavily infected with *P. falciparum* by mincing in a meat-chopper, extracting with ether, digesting the ether-insoluble portion in Coca's solution, may become acid. In the acid condition it is not reactive, but after adjustment to a pH of 7.8 it is an efficient antigen. Thus, 7 lots of this antigen with a pH of 7.8 in 154 tests on 64 serums, gave the following average results: 32 serums from infected persons gave 30 positive tests (4+++ , 11++ and 15+), 1 doubtful and 1 negative, and 32 serums from persons negative in the thick film gave 1 positive (+), 4 doubtful and 27 negative tests.

2. Five lots of an antigen, prepared from the blood squeezed out of a placenta infected with *P. falciparum* by concentrating the malarial parasites by centrifugation, drying *in vacuo* over sulphuric acid, digesting the dry powder in $n/20$ HCl for not over 20 hours, and adjusting the pH of the supernatant to about 7.8 with $n/20$ NaOH, gave the following results when tested with 78 serums: Serums from 34 infected persons gave 29 positive tests (3+++ , 14++ and 12+) and 5 negative tests; and serums from 44 persons not infected gave 9 positive tests (no+++ , 2++ and 7+), 3 doubtful positives and 32 negatives. It seems probable

TABLE 1

Precipitin results with antigens prepared from heavily infected placentas (*Plasmodium falciparum*): A., minced pulp extracted with ether and the ether-insoluble portion digested in Coca's solution; B., concentrated parasites from blood dried and treated with n-20 HCl; C., concentrated parasites from blood dried and extracted with Coca's solution under toluol

Num- ber	Malarial Diagnosis*	Malarial Treatment†	Intestinal Parasites	Kahn Test	Classification of Disease	Precipitin Results		
						A Coca- ether	B‡ Dried- Acid	C† Dried- Coca
1	E.A.	Q. gr. xv b.i.d. (2d.)	Hookworm; <i>A. lumbricoides</i> ; <i>E. coli</i>	-	Malaria	+++	++	++
2	E.A. 1	None	<i>A. lumbricoides</i> ; <i>T. trichiura</i> ; <i>E. coli</i> ;		Stricture of the urethra	+++	++	+++
3	E.A.	None	<i>T. hominis</i>	+	Dysentery, other than amoebic or bacillary	+++	+++	+++
4	E.A.	Q. gr. xv	Hookworm	-	Injury by cutting or piercing instruments	+++	+	+++
5	E.A.	Q. gr. xx b.i.d. (1½d.)	<i>T. hominis</i>		Malaria	+++	+++	+++
6	Ter.	None	Hookworm; <i>T. trichiura</i> ; <i>S. stercoralis</i>	-	Traumatism by vehicles, etc.	+++	+++	+++
7	E.A. 1	Q. gr. xv	Hookworm; <i>A. lumbricoides</i> <i>E. coli</i>	-	Influenza	+++	+++	+++
8	E.A.	Q. gr. xv b.i.d. (5d.)	<i>A. lumbricoides</i> ; <i>E. coli</i>		Injury by cutting or piercing instruments	+++	+++	+++
9	Ter.	None			Diseases of the bones and organs of locomotion	++	++	++
10	Ter.	Q. gr. xv b.i.d. (4)	<i>A. lumbricoides</i> ; <i>E. histolytica</i> ; Flagellates		Malaria	++	+	++
11	Ter. 1	None	Hookworm		Diseases of the eye, except gonococcal infection and tumor	++	+	++
12	E.A.	Q. gr. xx b.i.d. (2d.)	<i>A. lumbricoides</i> ; <i>S. stercoralis</i>	+++	Malaria	++	+	++
13	E.A.	Q. gr. xx b.i.d. (2½d.)	<i>A. lumbricoides</i>		Malaria	++		++
14	E.A.	Q. gr. xx b.i.d. (3d.)	<i>A. lumbricoides</i> ; <i>S. stercoralis</i>	+++	Malaria	++	-	++
15	E.A.	Q. gr. xv b.i.d. (1½d.)	Hookworm; <i>A. lumbricoides</i> ; <i>E. histolytica</i>		Amoebic dysentery	++	-	+++
16	E.A.	Q. gr. xv	<i>T. trichiura</i> ; <i>E. coli</i>	-	Malaria	+	++	+++
17	E.A.	P.C. II t.i.d. (5d.)	<i>A. lumbricoides</i>	++	Malaria	+	++	+++
18	E.A.	Q. gr. x b.i.d. (1d.)			Phlegmon, acute abscess	+	++	+++
19	E.A.	Q. gr. xv b.i.d. (2d.)	<i>E. coli</i> ; Flagellates	-	Malaria	+	++	+++
20	E.A. 1	P.C. II t.i.d. (2½d.)	Hookworm; <i>A. lumbricoides</i> ; <i>T. trichiura</i>		Malaria	+	++	+++
21	Ter. 1	Q. gr. x b.i.d. (4d.)	Hookworm; <i>A. lumbricoides</i> ; <i>E. coli</i>	-	Ankylostomiasis	+	++	+++
22	E.A.	None	Hookworm; <i>A. lumbricoides</i> ; <i>T. trichiura</i> ; Flagellates		Malaria	+	++	+++
23	E.A. 2	P.C. II t.i.d. (3½d.)	<i>A. lumbricoides</i>	-	Malaria	+	++	+++
24	E.A.	Q. gr. xv b.i.d. (2d.)	<i>A. lumbricoides</i>	+++	Malaria	+	++	+++
25	E.A.	Q. gr. xv	<i>A. lumbricoides</i> ; <i>T. trichiura</i> ; <i>S. stercoralis</i> ; <i>E. coli</i>		Gonococcal ophthalmia	+	+	+
26	Ter.	None	Hookworm		Malaria	+	+	+
27	Ter. 1	None	None	-	No disease; malingering	+	+	+
28	E.A.	None	None		Disease of bones and organs of locomotion	+	+	+
29	Ter. E.A.	Q. gr. xx	<i>T. trichiura</i> ; <i>S. stercoralis</i>		Malaria	+	+	+

31	E.A. 1	None	None	<i>A. lumbricoides; T. trichiura</i>	++++	Malaria	+	+
32	Ter. 1	Q. gr. v b.i.d. (1d.)	Q. gr. v b.i.d. (1d.)	Hookworm; <i>T. trichiura</i>	-	Treated for chronic malaria during previous year	+	+
33	Neg.	None	None	None	-	Ankylostomiasis	+	+
34	Neg.	Q. gr. xx b.i.d. (1½d.)	Q. gr. xx b.i.d. (1½d.)	Hookworm; <i>T. trichiura</i>	-	Diseases of bones and organs of locomotion	+	+
35	Neg.	None	None	None	-	Scabies	+	+
36	Neg.	None	None	<i>E. histolytica</i>	++++	Abortion	+	+
37	Neg.	None	None	None	-	Injuries by animals (not poisoning)	+	+
38	Neg.	None	None	None	-	Ankylostomiasis	+	+
39	Neg.	Q. gr. xx b.i.d. (1d.)	Q. gr. xx b.i.d. (1d.)	Hookworm	-	Non-venereal diseases of female genital organs	+	+
40	Neg.	None	None	<i>E. coli</i>	-	Chorea, hysteria and neuralgia	+	+
41	Neg.	None	None	Hookworm; <i>T. trichiura; E. coli</i>	-	Diseases of the ear	-	-
42	Neg.	None	None	Hookworm; <i>A. lumbricoides; T. trichiura; E. coli</i>	-	Fractures	-	-
43	Neg.	None	None	<i>T. trichiura</i>	-	Injury by firearms	-	-
44	Neg.	None	None	Hookworm; <i>A. lumbricoides; E. coli</i>	-	Injury by cutting or piercing instruments	-	-
45	Neg.	None	None	Hookworm; <i>A. lumbricoides; T. trichiura</i>	-	Acute abscess	-	-
46	Neg.	None	None	Hookworm; <i>A. lumbricoides; T. trichiura; S. stercoralis; E. coli</i>	++	Tertiary syphilis	-	-
47	Neg.	Q. gr. xv	Q. gr. xv	<i>A. lumbricoides; T. trichiura</i>	-	Amoebic dysentery	-	-
48	Neg.	None	None	<i>A. lumbricoides; T. trichiura; E. histolytica; E. coli; Flagellates</i>	-	Influenza	-	-
49	Neg.	Q. gr. b.i.d. (2d.)	Q. gr. b.i.d. (2d.)	Hookworm; <i>T. trichiura</i>	-	Infections of undetermined origin	-	-
50	Neg.	Q. gr. xx; Q. gr. xv b.i.d. (1d.); Q. gr. x b.i.d. (1d.)	Q. gr. xx; Q. gr. xv b.i.d. (1d.); Q. gr. x b.i.d. (1d.)	<i>A. lumbricoides; T. trichiura</i>	-	Fractures	-	-
51	Neg.	None	None	None	-	Malingering	-	-
52	Neg.	None	None	None	-	Diseases of the bones (tuberculosis excepted)	-	-
53	Neg.	None	None	None	-	Chorea	-	-
54	Neg.	None	None	Hookworm; <i>A. lumbricoides; T. trichiura</i>	+	Malaria	-	-
55	Neg.	Had been treated previously for malaria	Had been treated previously for malaria	<i>A. lumbricoides</i>	-	Influenza	-	-
56	Neg.	Q. gr. xv b.i.d. (1½d.)	Q. gr. xv b.i.d. (1½d.)	None	-	Non-venereal diseases of kidneys, etc.	-	-
57	Neg.	Q. gr. xx Q. gr. xv b.i.d. (1d.)	Q. gr. xx Q. gr. xv b.i.d. (1d.)	Tapeworm	-	Diseases of the eye except gonococcal infection	-	-
58	Neg.	None	None	None	-	Burns and scalds	-	-
59	Neg.	None	None	<i>A. lumbricoides; E. coli</i>	-	Injury by cutting or piercing instruments	-	-
60	Neg.	None	None	None	-	Infections of undetermined origin	-	-
61	Neg.	None	None	<i>T. trichiura</i>	-	Benign tumors of uterus	-	-
62	Neg.	None	None	<i>E. coli</i>	-	Diseases of bones and organs of locomotion	-	-
63	Neg.	None	None	<i>E. coli</i>	-	Infections of undetermined origin	-	-
64	Neg.	Q. gr. xx	Q. gr. xx	None	-	Infections of undetermined origin	-	-

* All diagnosis made by Berber thick-film method; E.A. *P. falciparum*; Ter., *P. vivax*. A numeral following the parasite symbol indicates the number of organisms found, where they were very few. † Q, quinine sulphate; P.C., 100 mg. tablets of plasmodium compound containing 0.01 gm. plasmodium and 0.125 gm. quinine sulphate. In each case the size, frequency and length of dosage are given. Thus, 1 Q, quinine sulphate, for 3 days, means 100 mg. quinine were given twice daily for 3 days.

2. gr. xv b.i.d. (2d.) signifies that xv grs. quinine were given twice daily for 2 days.

A complete summary of the results with this antigen including 24 other cases is given in Table 1. A complete summary of results with this antigen, including 14 other cases, is given in Table 2. A complete summary of results with this antigen, including 14 other cases,

90-1-1

that the dried concentrate can be preserved over long periods. Preliminary tests with an antigen prepared by extracting the same type of concentrate with Coca's solution and preserving under toluol, also gave promising results.

3. No marked success was obtained with various antigens prepared from an infected spleen or from concentrated cultures.

TABLE 2

EFFECT OF AGE ON THE REACTIVITY OF SERUM AS TESTED AGAINST THE COCA-ETHER ANTIGEN

Age in Days				
Fresh	1	2	3	4
+++	+++			
+++	+++	+++		
+++	++	+		
++		++		
++	++	+		
++				+
++		+		
++	++			
++	++			
++	+			
++	+			

TABLE 3

PRECIPITIN RESULTS (78 CASES) WITH AN ANTIGEN PREPARED FROM A HEAVILY INFECTED (*P. falciparum*) PLACENTA BY CONCENTRATING THE PARASITES, DRYING, DIGESTING IN HCl AND NEUTRALIZING WITH NaOH

Results of Blood Examination	Precipitin Results					Total Number of Cases Omitting Doubtful Readings, Giving:	
	+++	++	+	+	—	Positive Precipitin Tests	Negative Precipitin Tests
Positive in Thick Film . .	3	14	12		5	29	5
Negative in Thick Film . .		2	7	3	32	9	32

TABLE 4

CORRELATION BETWEEN RESULTS OBTAINED WITH TWO ANTIGENS MADE FROM THE SAME INFECTED PLACENTA: THE FIRST PREPARED BY TREATING THE WHOLE MINCED PLACENTA IN ETHER AND DIGESTING IN COCA'S SOLUTION, AND THE SECOND, BY TREATING A DRIED CONCENTRATE OF THE MALARIAL PARASITES WITH N/20 HCl. (EACH WAS ADJUSTED TO pH 7.8 BEFORE USING.)

		Acid Antigen				
		+++	++	+	+ ²	-
Coca-ether Antigen	+++	1	2	1		
	++	2	3	2		2
	+		7	4		1
	+ ²			1	1	2
	-			4	1	20

THE PNEUMOCOCCI, BY TYPES, IN CULTURES FROM 71 AUTOPSIES

H. C. CLARK, M.D.

Medical Department, United Fruit Company

Since I have frequently been asked about the types of pneumococci found in our Caribbean medical services, it seems desirable to record available data from Panama, which is more or less centrally located with regard to many of the Company's plantations. Our own medical services have not given this question any attention, but I can cite 71 cases studied at autopsy soon after death. Drs. L. B. Bates and J. H. St. John did the bacteriological examinations on cultures that I took from my autopsy service in the Board of Health Laboratory, Ancon, Canal Zone. Those desiring the complete reports concerning the general bacteriological findings on most of these cases, can find them in the *Proceedings of the Medical Association of the Isthmian Canal Zone*, Vol. XIII, Parts 1 and 2, page 17. Their article also includes the results on 400 nasopharyngeal cultures, 220 sputa, 94 blood cultures, etc., taken during an influenza epidemic in the Canal Zone. All of the individuals in this series of 71 autopsies died in Panama during the years of 1919 to 1922, inclusive.

TABLE I
CAUSES OF DEATH RECORDED IN THE SERIES

Disease	Negro Adults	Negro Children	Latin- American Adults	Latin- American Children	Total
Pneumonia	8	13	17	0	38
Meningitis	2	3	2	1	8
Endocarditis	1	0	1	0	2
Tuberculosis	1	3	1	0	5
Methyl alcohol pos.	1	0	0	0	1
Organic heart dis.	1	0	0	0	1
Malnutrition	0	6	0	0	6
Infantile beri-beri	0	1	0	0	1
Colitis	0	1	0	0	1
Otitis and mastoiditis	0	2	0	0	2
Pyæmia, staphylococcic	0	1	0	0	1
Volvulus	0	1	0	0	1
Bacillary dysentery	0	1	0	0	1
General paralysis In.	0	0	1	0	1
Cancer of æsophagus	0	0	1	0	1
Anaemia	0	0	0	1	1
	14	32	23	2	71

TABLE II
ORIGIN OF CULTURES AND TYPES OF PNEUMOCOCCI FOUND

Origin	Number of Cultures	Type I	Type II	Type III	Type IV	I and II Mixed
Lung parenchyma	20	2	2	1	14	1
Bronchus	7	0	1	2	4	0
Trachea	6	0	0	0	6	0
Pleural sac	3	1	0	0	2	0
Naso-pharynx	1	0	0	0	1	0
Sinuses, accessory	13	2	1	1	9	0
Middle ears	34	1	4	2	27	0
Mastoid	3	0	1	0	2	0
Heart's blood	27	6	1	2	17	1
Pericardium	4	2	0	0	2	0
Meninges	9	2	3	0	4	0
Peritoneum	1	0	0	0	1	0
	128	16	13	8	89	2

TABLE III
TYPES OF PNEUMOCOCCI, BY RACE AND AGE

Pneumococci	Negro Adults (14)	Negro Children (32)	Latin- American Adults (23)	Latin- American Children (2)	Totals
Type I	6	5	5	0	16
Type II	1	5	7	0	13
Type III	1	1	6	0	8
Type IV	21	41	25	2	89
Types I and II Mix. . . .	2	0	0	0	2
	31	52	43	2	128

Park* states that

Through the work of Cole, Neufeld and others, it was learned that in North America and Europe there were 3 dominant types which, in normal years, accounted for about 60% to 80% of all cases of lobar pneumonia. These were, therefore, named Types I, II and III. The remainder of the cases were due to other types. . . . For convenience we include all of these miscellaneous types as Type IV. . . . At the present time in New York City, Type I occurs in about 30% of the cases of lobar pneumonia, Type II in about 20%, and Type III in about 15%. The other types of pneumococci occur in about 25%; these, for convenience, are considered as Type IV, but really are as different among themselves as Types I, II and III. The remainder are due to streptococci or other infrequently occurring bacteria.

Park* also states that during the influenzal outbreak there was a complete reversal of the numbers due to the 3 main types, and that the types bunched together under Type IV.

It should be understood that an influenzal epidemic was present in Panama during 1919-1920, and that this may account for the large number of cases found in the Type IV column of Table 3. Type I pneumococci occurred in 13.3 per cent, Type II in 11.7 per cent, and Type III in 6.2 per cent, while 69.5 per cent fell under Type IV.

LIVER-CELL CARCINOMA AND TOXIC CIRRHOSIS**

F. B. MALLORY, M.D.

Primary carcinoma of the liver is a relatively rare tumor. The liver-cell type is still rarer, and is almost always associated with cirrhosis. The occurrence of five examples of this variety of new growth in the autopsies performed at the hospitals of the United Fruit Company during the past three years, therefore, seems to call for brief comment.

* William H. Park, "Use of Vaccines and Pneumonia Antibody in the Treatment and Prevention of Pneumonia, and the Use of Convalescent Serum in the Prevention of Measles," *Internat. Confer. Health Problems in Trop. America*, Published by United Fruit Co., 1924, pp. 834-836

** From the Pathological Laboratory, Boston City Hospital, Boston, Mass.

The records of the Pathological Laboratory of the Boston City Hospital for the past 31 years show that there have been 329 cases of cirrhosis among 6,340 post-mortem examinations. An analysis of the different types encountered reveals the following figures:

Total Boston City Hospital Autopsies, 1897-1927 inclusive			6,340
No. of cases of cirrhosis	329		5.2%
<i>Types</i>			
Alcoholic	139	42.2%	} 72. %
Pigment	46	14. %	
Alc. and pigment	52	15.8%	
Toxic	31	9.4%	
Syphilitic	15	4.5%	
Infectious	14	4.3%	
Type not determined	32	9.7%	

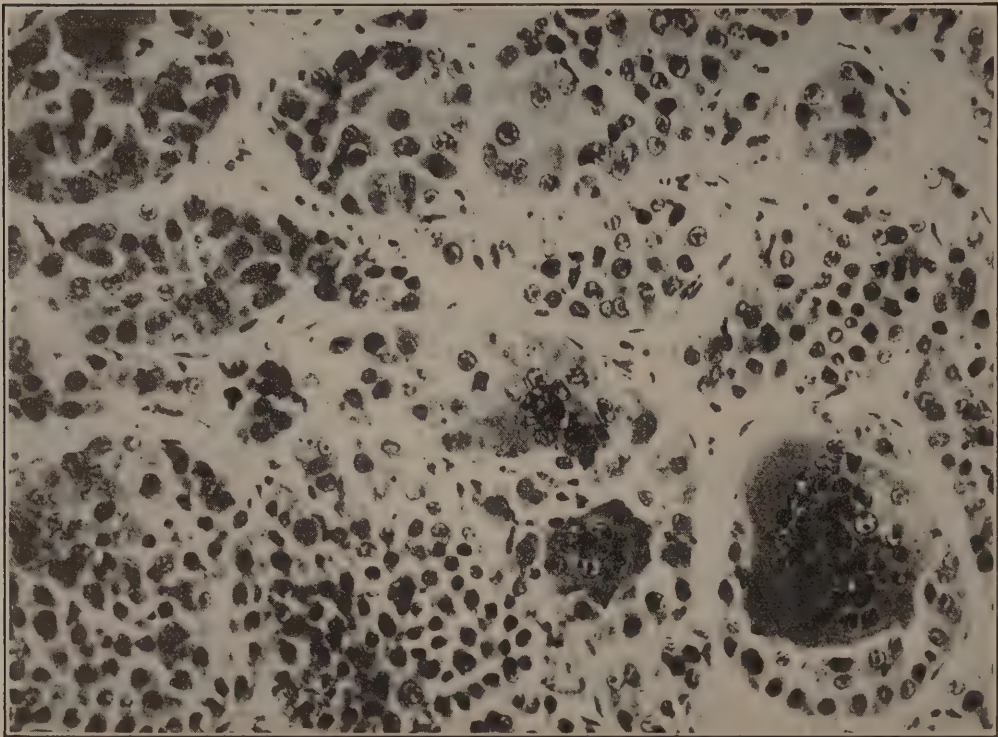


FIG. 1

FIG. 1. UFA 62. A low power photomicrograph showing various degrees of differentiation of the cells in a liver cell carcinoma. Several tumor giant cells present. X 250

During this same period there have occurred 8 cases of liver-cell carcinoma, of which 7 were associated with cirrhosis, 2 with the pigment type, 3 with the pigment and alcoholic types combined, and 2 with toxic cirrhosis. Tissues

from 4 other cases of liver-cell carcinoma have been sent to the laboratory,—3 of complicated pigment cirrhosis and 1 of toxic cirrhosis.

An examination of the 46 cases of pigment cirrhosis (hemochromatosis) discloses that 10 occurred during the 22 years from 1897 to 1918, inclusive, and 36 during the past 9 years from 1919 to 1927 inclusive; that is, there have been almost 4 times as many cases of pigment cirrhosis during the past 9 years as during the preceding 22 years. The cause of the marked increase in this type of cirrhosis would seem to be due chiefly to the poor quality of the liquor

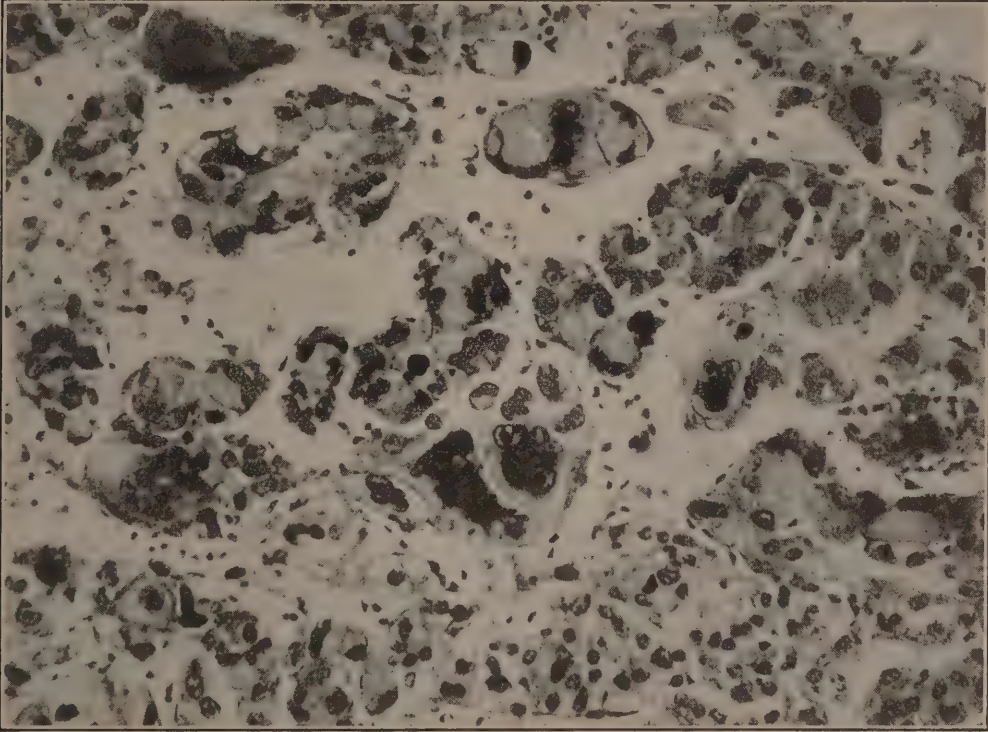


FIG. 2

FIG. 2. UFA 104. A second liver cell carcinoma containing many tumor giant cells, some with large lobulated and others with multiple nuclei. $\times 250$

obtainable since prohibition went into effect. Examination of nearly 2,000 samples of "hooch" by the state chemist of Massachusetts showed that over 10 per cent of them contained copper in amounts varying from a mere trace up to 39 mg. to the liter. Copper salts taken into the body cause hemolysis. The haemoglobin set free from the red-blood corpuscles is eliminated in limited amount through the kidneys. Any excess is deposited as hemofuscin in the liver, where it is gradually changed to hemosiderin. If the pigment accumulates in the liver cells in sufficient amount, it causes pigment cirrhosis by producing necrosis followed by regeneration.

In pigment cirrhosis we have a very chronic process, lasting, ordinarily, many years, in which necrosis and regeneration of liver cells are constantly occurring. Finally, in a certain number of cases one of the cells becomes independent of body control, proliferates, and grows as a carcinoma which eventually causes the death of the individual. While an analogous process takes place in alcoholic cirrhosis, no example of its giving rise to liver-cell carcinoma occurs in this series.

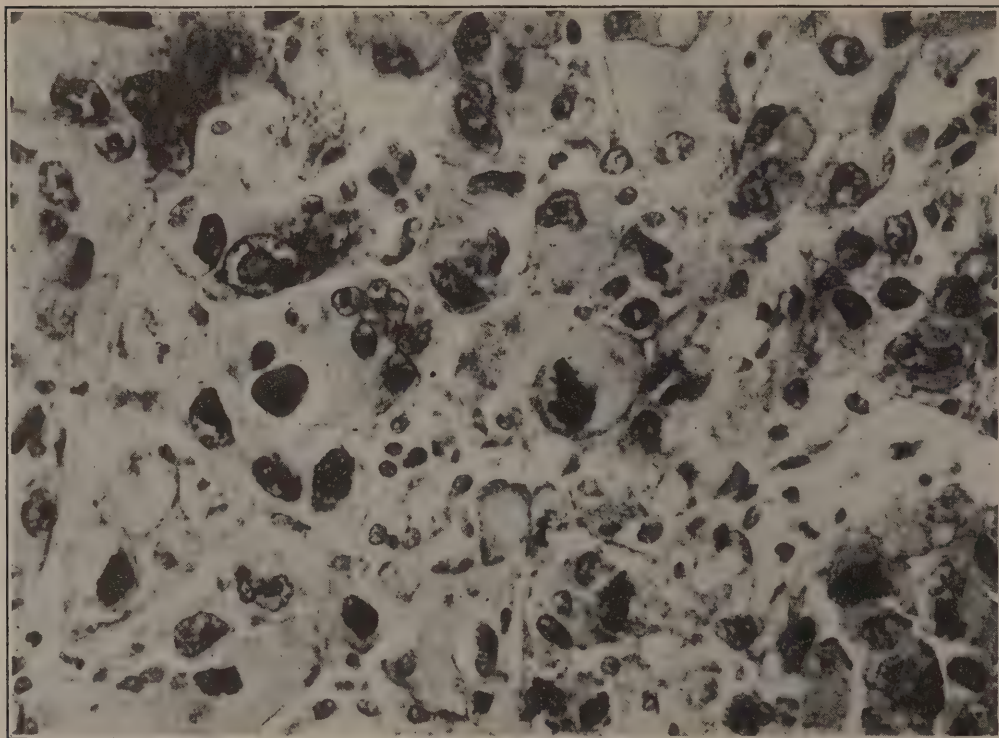


FIG. 3

FIG. 3. UFA 104. Near the center are two large cells, one containing a large mitotic figure, the other a number of nuclei and two rounded masses of inspissated bile lying in vacuoles. $\times 500$

It is interesting to note that the 5 cases of carcinoma associated with pigment cirrhosis, either alone or combined with the alcoholic type, all occurred during the past 9 years, during which time the incidence of pigment cirrhosis has increased so greatly.

In toxic cirrhosis an entirely different condition obtains. A strong toxin, such as phosphorus, for example, causes extensive necrosis of liver cells. If the patient survives, the necrotic cells are dissolved and removed, resulting in the condition known as acute yellow atrophy. The next stage is active regeneration from the liver cells which have not been killed. In the lobules

where all the liver cells have undergone necrosis, only connective tissue stroma, blood sinusoids, and bile ducts remain. In time these areas contract and form foci of sclerosis. The final result is the coarsely nodular type of cirrhosis which follows recovery from acute yellow atrophy. It is commonly called, for the sake of brevity, toxic cirrhosis.

Material from 15 cases of cirrhosis has been received from the United Fruit Company hospitals during the past 3 years. A histological study of them shows that they can be grouped into the following types; toxic cirrhosis, 10 cases; infectious cirrhosis, 3 cases; syphilitic cirrhosis, 2 cases. Not a single example of pigment or of alcoholic cirrhosis has been seen.

Of the 5 cases of liver-cell carcinoma received from these same hospitals, 3 came from the Truxillo Railroad Hospital, one from the Panama Division, and one from the Banos Division. The patients were all males, and varied in age from 24 to 52 years. Three of the cases of cancer complicated toxic cirrhosis; in the 4th, well marked sclerosis of the liver was present in some of the sections, but the exact type of cirrhosis could not be determined. In the 5th case, practically only tumor tissue was received so that it was impossible to state definitely whether cirrhosis was present or not. While only 3 of the 5 cases can be claimed positively to have followed toxic cirrhosis, it seems probable that all 5 were due to proliferative activity as a result of injury due to toxic lesions. Sometimes regeneration is so complete that no sclerosis results or the few patches of it present may be readily overlooked.

Liver-cell cancer usually forms a more or less spherical mass, which at the periphery tends to invade the surrounding liver tissue. However, it frequently grows into the hepatic and portal veins and spreads through them, giving rise to multiple nodules throughout the organ.

Histologically the liver-cell cancer is fairly characteristic. The cells often grow in columns separated by thin-walled blood-vessels, but sometimes large alveolar masses are formed. The connective tissue stroma is usually slight in amount. If the tumor is growing rapidly, its cells may show little differentiation. As a rule, however, they tend to differentiate, at least in places like liver cells. Sometimes it is difficult to tell columns of tumor cells from the normal ones, except by the fact that the tumor cells are almost invariably larger. Mitotic figures are often numerous and occasionally multiple, giving rise to tumor giant cells which may contain dozens to hundreds of nuclei.

The most characteristic feature of the liver-cell cancer is, of course, the production of bile. This may occur in irregular branching inspissated masses in dilated bile capillaries, or as brownish droplets within the liver cells.

Metastases from liver cell cancers are not very common. In the United Fruit Company series of five they occurred but once and those were situated in the lungs. Metastases to the regional lymph nodes occur most frequently; the lungs come next, and the tumor may extend from them into the pleural cavities. In one case whose organs were brought to the laboratory, the cancer

grew into the hepatic vein and extended through it and the inferior vena cava into the heart. Some of the tumor cells became attached to the tricuspid valve and developed into a mass several centimeters in extent, which was mistaken at first for a vegetation of infectious origin. Metastases to the bone marrow are on record.

The unusual feature of these liver-cell cancer statistics from the United Fruit Company hospitals is the high percentage of malignant new growths (5) as compared with the number of cases of cirrhosis, 15 or at the most 17, namely 29 to 33.3 per cent. The percentage in the Boston City Hospital series is very much lower, only 2.3.

De Vogel has recently called attention to the high frequency of primary carcinoma of the liver in the Javanese and the Chinese. Ninety per cent of such carcinomas were found in cirrhotic livers. In the Boston City Hospital statistics given above, 2 of the 3 cases of toxic cirrhosis complicated with liver-cell carcinoma were in Chinese. On the other hand, in 13 cases of cirrhosis of toxic and schistosomal origin received from Peking, none was complicated by carcinoma of the liver.

Various injurious agents can cause toxic cirrhosis,—for example, phosphorus, arsenic, antimony, carbon tetrachloride, and toxins derived from bacteria, especially from some of the streptococci. What the causes were in the cases included in these statistics, it is impossible to say. Possibly the clinicians in the hospitals, by studying cases which come under their care in the future, may occasionally be able to obtain some definite information which would be of value.

BANES LABORATORY REPORT—1927
ADDITIONAL AND EXPLANATORY NOTES TO THE
CONSOLIDATED LABORATORY REPORT

WALTER MENK, M.D.

United Fruit Company Hospital
Banes, Cuba

Bacteriological, serological, and parasitological work has been increased considerably during the year. It is now possible, with the amount of material at hand, to give a short report concerning the more interesting infectious diseases observed in the Banes Division.

DISEASES CAUSED BY PROTOZOA

Malaria.—The parasite rate has been determined by 2 field surveys; the first one was done in April and May 1927, at the close of the harvest season; and the second in September and October, 1927. This latter survey ended just as the rainy season started. The following condensed records of both of these can now be given in a brief tabular manner:—

FIELD SURVEY IN APRIL-MAY, 1927

Races Examined	Number Examined	Number Positive for Malaria	Per Cent Positive for Malaria
Negroes, chiefly Haitians . . .	628	289	46
Cubans, Spaniards, etc. . . .	50	8	16
	678	297	43.8

Species of Parasites	Negro Cases	Cuban, Spaniard Cases
Aestivo-autumnal	237 (82.0%)	3 (37.5%)
Tertian and quartan	52 (17.9%)	5 (62.5%)

Crescent-carriers found in the negroes were 118 (49.8%) in 237 aestivo-autumnal cases. Crescent-carriers found in Cubans, etc., 1 (33.3%) in 3 aestivo-autumnal cases. Heavy infections among the Haitians were 59 (20.4%) in 289 positives. Heavy infections among the Cubans were 3 cases (37.5%) in 8 positives.

FIELD SURVEY IN SEPTEMBER-OCTOBER, 1927

Races Examined	Number Examined	Number Positive for Malaria	Per Cent Positive for Malaria
Negroes, chiefly Haitians . . .	139	31	22.3
Cubans, Spaniards, etc. . . .	208	20	9.6
	347	51	14.7

Species of Parasites	Negro Cases	Cuban, Spaniard Cases
Aestivo-autumnal	25 (80.6%)	12 (60.0%)
Tertian and quartan	6 (19.3%)	8 (40.0%)

Crescent-carriers found in the negroes were 11 (44%) in 25 aestivo-autumnal cases. Crescent-carriers found in the Cubans, etc., were 3 (25%) in 12 aestivo-autumnal cases. Heavy infections found in the negroes were 3 (9.7%) in 31 cases. Heavy infections found in the Cubans were 2 (10.0%) in 20 cases.

Deleite (Tacajo) is the center of one of our agricultural districts. In former years it was a hot-bed of malaria and blackwater fever. The conditions in this region have been very greatly improved during the year 1927. The second field-survey, September-October, shows a decided drop in the blood-parasite index. This drop corresponds to a still more pronounced decline in the number of malaria cases admitted to the hospital during the different months of the year. The reduction of malaria toward October is due to the long dry-season, quinine treatment, anti-mosquito measures, and changes in the general living conditions. During the harvest season, the negro laborers form a dense camp population, performing arduous work. During the *dead season* following the

harvest very few negroes remain in the farm camps, and their work is not of an arduous nature. During 1927 we reported 38 cases of blackwater fever. (See our special report on this subject, p. 113.)

Intestinal protozoa. — The results of the stool-examinations, as shown in the Consolidated Laboratory Report (p. 354), do not afford a correct idea of the incidence of intestinal protozoa. No stool is examined for protozoa until a special request is made for such an examination. The result is that such requests are made only regarding stools of a dysenteric character. During the months of November and December, I examined stools from 139 unselected hospital and dispensary cases. Fresh unstained films and iodine-stained films were controlled by the wet-fixation iron-haematoxylin method. I found protozoa in 41 per cent and the ova of worms in 41 per cent of the cases. The details are given in the following table:—

INTESTINAL PROTOZOA IN HOSPITAL AND DISPENSARY CASES

Total Number of Cases Examined, 139 Number of Cases Showing Protozoa in Stools, 57—or 41 Per Cent							
Cases of Intestinal Amoebae, 51 (37%)				Cases of Flagellates, 15 (11%)			
<i>E. histolytica</i>	<i>E. coli</i>	<i>E. nana</i>	<i>I. bütschlii</i>	<i>Chilomastix mesnili</i>	<i>Trichomonas</i>	<i>Giardia lamblia</i>	Not Identified
24 cases With vegetative forms in 7 cases With cysts, alone, in 17 cases	18	20	8	3	3	6	3

The vegetative forms of the amoebae (*E. histolytica*) can be further divided into 4 cases showing the large vegetative forms, and 3 cases with minuta-forms. Some cysts of *E. histolytica* were also present. In the group of 17 cases showing cysts, there were 4 cases with cysts of the small strain of *E. histolytica* (*E. tenuis*). Blastocysts were very common, and sometimes were abundant in the stools. Infections with more than one kind of intestinal protozoa were noted. Less than one-third of the patients with *E. histolytica* showed characteristic vegetative forms. All of these cases had stools with macroscopic or microscopic evidence of dysentery, and all presented a history of dysentery or colitis. We had comparatively more cases of amoebic and bacillary dysentery in November and December than during the rest of the year, and the cases were in our permanent inhabitants. The results of the series check closely with those of my former surveys in which the iron-haematoxylin method was not used. The percentage of flagellates was low this time, as compared with the rate of 22 per cent in a former series.

It is true that classical amoebic dysentery is not frequently observed in our hospital. In many of the obscure cases of colitis, a close examination of the stools often discloses amoebae. The iron-haematoxylin method is of value in these cases. Heavy flagellate infections may cause intestinal trouble, especially in children. Our series of cases,—hospital and dispensary patients—can not be considered a true reflection of the rate of these parasites in the general population. It does emphasize the importance of exact stool-examinations. An examination of the stool for worms is not sufficient in many cases.

SYPHILIS AND YAWS

Some conclusions regarding the incidence of *Treponema* infections in our hospital and dispensary cases can be drawn from the tests made in our laboratory on the various classes of our inhabitants. The test employed was Meinicke's Turbidity Reaction (M.T.R.). No routine test is applied to either our hospital or our dispensary service, and yet a fair number of people have been tested. We obtained the following results in a series of 568 hospital and dispensary cases examined in 1927, in which sufficient exact details are available. The race indices follow:

Class of People Examined	Number Examined	Per Cent with Positive Result	Per Cent with Normal Sera	Per Cent of Ill-defined Reactions
Cubans and Spaniards	194	6	88	6
Haitian negroes	258	50	39	11
Other negroes	116	23	70	7

A classification according to age shows the following results in the group of Cuban and Spaniard race, and the group of Haitian negroes. C will indicate the first group and H will indicate the Haitian negroes.

Result of the M.T.R. Tests	Age of Patients Examined							
	10-20 Years		20-30 Years		30-40 Years		Above 40 Years	
	C.	H.	C.	H.	C.	H.	C.	H.
M.T.R. % strongly positive	0	43	5	54	12	48	7	62.5
M.T.R. % negative	89	48	90	38	82	34	90	31

This table does not record the doubtful reactions. Only those are recorded that were definitely positive or negative.

In the group of Cubans and Spaniards there were no cases of clinical yaws, and the incidence of positive reactions for this group has no doubt been lowered by syphilitic treatment. The Haitian group shows the serological picture of a

population highly infected with yaws as well as syphilis. It must be emphasized that cases of classical primary and secondary yaws are very rare in the Haitian negroes used as laborers in our division. Clinical evidence of an old yaws infection in most of the cases is shown by polyscleradenitis, scars of the shin, bone affections (especially periostitis of the tibiae), keratoma plantare et palmare, and less frequently, gummatous lesions and specific arthritis. Juxta-articular nodosities and vitiligo or caraate-like depigmentations (especially on the hands) are occasionally seen.

PARASITIC WORMS

Intestinal Helminths. — The results of our routine laboratory examinations on a total of 2,330 stools (employing the simple slide-emulsion technique) are as follows: Of the specimens examined, *uncinaria* was found in 12.7 per cent; *trichocephalus* in 22.2 per cent; ascaris in 18.6 per cent. The percentage found is too low, especially for *uncinaria*, as I have convinced myself by parallel examinations. Slight infections are not found by the simple slide-emulsion method, while they are easily detected by the concentrated salt-solution flotation method which, in my experience, is the most efficient and practical concentration method for the diagnosis of uncinariasis. In the series of 139 cases already analyzed for intestinal protozoa, I found our permanent inhabitants showed *uncinaria* in 22 per cent, *trichocephalus* 23 per cent, and ascaris in 7.2 per cent. We found in Haitian laborers the incidence of uncinariasis and ascariasis to be far more frequent than in Cubans.

DISEASES CAUSED BY BACTERIA

Cocci. — In 2 cases *Staphylococcus aureus* was isolated by blood culture. A *Streptococcus* was isolated in a case of puerperal septicaemia.

Pneumococcus. — The results of blood-cultures and sputum-examinations show, in our acute respiratory diseases, that the pneumococcus is usually the exciting organism. No typing has been done. This organism has also been recovered from spinal-fluid specimens.

Diplococcus Intracellularis Meningitidis. — Cases of acute cerebrospinal meningitis are not very frequent. Besides meningitis caused by the pneumococcus, there occasionally occurs a case of the epidemic form of meningitis. During the present year we have had 5 cases of acute purulent meningitis, from which we isolated *Diplococcus intracellularis meningitidis*; 3 of the cases died. In 3 additional cases of purulent meningitis we were unable to find any organism. Of the 10 cases of purulent meningitis, 9 occurred in Haitian negroes and one in a Cuban boy 13 years of age. As the occurrence of epidemic meningitis is unusual in this country, I should like to give some details.

Dr. Cordes, while in Banes a few years ago, observed that in Haitian laborers, occasionally, meningitis cases were seen which were caused by intracellular, Gram-negative diplococci of the general morphology and cultural features of the meningococci. His findings have been confirmed by me. Lately, I had the opportunity to do work in detail on one of these cases. In a typical case of meningitis (a young Haitian laborer admitted in an unconscious state) I obtained a Gram-negative, coffee-bean-shaped diplococcus from a blood-culture and a culture from the purulent spinal fluid. The first culture medium used in both specimens was dextrose broth; 10 cc. of blood and 3 cc. of spinal fluid were planted. It grew characteristically in the subcultures on blood-streaked agar and ascitic agar, but no visible growth occurred on common agar. The primary and subcultures were controlled by Gram's stained preparations. Polyvalent agglutinating meningococcic serum (horse) agglutinated a suspension of the diplococci recovered from the blood culture up to the titer limit, while physiological serum and 1 : 50 normal horse-serum did not agglutinate them. The blood serum of the patient (specimen taken after death) agglutinated a suspension of *Meningococcus*, Type I, after 14 hours in 1 : 40 dilution, and after 24 hours in 1 : 320 dilution. The controls with physiological serum and the corresponding dilutions with *Meningococcus* II suspension did not show changes.

Films prepared at the autopsy of this case confirmed the ante-mortem findings. In contrast to the usual fulminating course of pneumococcic meningitis, a considerable percentage of these cases showed a more protracted course. The fever was often comparatively low and irregular. The prognosis is not as grave as in pneumococcic meningitis. Epidemics of this form of meningitis have not been observed. This small series of cases came from scattered regions in the division. Direct connection is not probable.

Bacilli of the Typhoid, Paratyphoid, and Dysentery Groups. — Typhoid fever is rarely observed in the Haitian negroes, yet it is not uncommon in the native population. It is much more frequent than the paratyphoid fevers. I have recovered *Bacillus typhosus* Eberth from 26 blood cultures, while *Bacillus paratyphosus* A. and B. were each isolated in one instance. The season in which most of these cultures were made was from June to December. Eleven of them were from cases under treatment in the months of October and November. Typhoid fever was observed almost exclusively in the two districts of Banes and Los Angeles. It seems chiefly to have occurred as a house or family epidemic in rural regions where the water supply, unhygienic disposal of stools and urine, general filthiness, and abundant fly-breeding explain its presence. Typhoid fever occasionally showed a tendency to run a very chronic course with relapses. Perforation and intestinal haemorrhage were not very frequent. The case (a Cuban) in which *B. paratyphosus* A. was recovered showed the clinical picture of a slight attack of typhoid fever. The paratyphoid B. case was rather an unusual one. The patient was a Haitian laborer 19 years of age. He had very high fever and symptoms of a lesion in the lower lobe of the left lung,

as well as symptoms of peritonitis in the left, upper quadrant. The blood culture and the culture from a little sanguinolent fluid aspirated from the left pleural cavity were both positive for *Bacillus paratyphosus* B. The patient died after one day's stay in the hospital. The autopsy, performed by Dr. Cordes, revealed an atelectasis of the lower lobe of the left lung and a slight pleuritis. The main lesion disclosed by the autopsy was an abscess of the slightly enlarged spleen with local adhesions and an early stage of general peritonitis. This case is interesting as splenic abscesses are comparatively rare. Dr. Cordes informs me that he has seen, in Hamburg, a similar case of abscess of the spleen associated with *B. paratyphosus* B.

The importance of taking blood cultures in every uncertain case of fever is emphasized by the following case:

A Jamaican negro, aged 35 years, was admitted to the hospital in an unconscious state. His condition resembled uraemic coma and was accompanied by a high fever. His wife gave us the history that the patient's urine had been red since the early morning hours of the day he was admitted to our hospital. The dark-brown urine contained large amounts of albumin and haemoglobin; brownish, dust-like sediment; no casts; no red-blood cells. The blood serum showed a dark brown-red color. A preliminary diagnosis of uraemia during haemoglobinuric fever was made. The patient died after a few hours and an autopsy was refused by the relatives. We were surprised to find that the blood culture taken before death became positive for *B. typhosus*.

Note Concerning Blood Culture Technique. — I have used exclusively the vacuum ampoules, containing sterile bile and sterile dextrose-broth, manufactured by the Behring Werke, Marburg Lahn, Germany, for the taking of blood cultures outside the hospital. The trade name for these ampoules is Venuelen. The ampoules combine an aspirating syringe and a culture medium in an easily handled, simple piece of apparatus. They will keep for years, even in a tropical climate. I would recommend that every laboratory which is in a position to do bacteriological work obtain a stock of the Venuelen apparatus for outside cases and for cases in the hospital during rush times.

Dysentery Bacilli. — Sporadic cases of bacillary dysentery have been observed during the last half of the year 1927. I isolated in 2 non-amoebic cases of dysentery *B. dysenteriae* Flexner, and in 2 other cases *B. dysenteriae* Y. The cases were in people who are permanent inhabitants of Cuba. *B. dysenteriae* Shiga was not found. Quite recently I recovered from the stool of a Haitian negro who was afflicted with a slight attack of non-amoebic dysentery, a growth of *B. dysenteriae* Y.

Diphtheria. — I have twice observed *B. diphtheriae* Klebs-Loeffler in cases suspected of having diphtheria.

Skin Diseases Caused by Bacteria and Fungi. — Impetigo contagiosa has been observed several times, and, according to information from Dr. Ariza, it is frequently seen. In cultures from unbroken vesicles *staphylococci* and *streptococci* were found. The smears from one case also showed intrapoly-nuclear diplococci resembling pneumococci, but no capsules were present.

Skin fungi are rather common. Most of the patients examined were Cubans with chronic pityriasisiform eruptions. *Tinea flava* is frequently seen, and occasionally we have seen *Tinea alba* and *Tinea nigra*. In most cases the fungi were easily and abundantly found in scrapings from the lesions. They were *Malassezia*- and *Cladosporium*-like organisms. No cultures were made. According to my experience, the most convenient method for examining fungus elements in pityriasisiform eruptions is to stain preparations with Giemsa solution and examine them with the oil-immersion lens. The material scraped from the lesion is placed between two slides which are firmly pressed together for a short time and then separated. Simply extract the fat with ether, and stain with a Giemsa solution as in thick blood-film preparations.

Autopsy Review.— We have performed autopsies during the year only on cases in which the clinical diagnosis was uncertain. The following notes are recorded:

- Autopsy No. 1—Cardio-vascular paralysis during an operation for hernia
- Autopsy No. 2—Carcinoma of stomach, pyloric stenosis, cachexia
- Autopsy No. 3—Carcinoma of the liver with metastases to the lungs
- Autopsy No. 4—Abscesses of the liver, multiple. Pneumonia, hypostatic.
- Autopsy No. 5—Fracture of the skull
- Autopsy No. 6—Malaria, cerebral. Pneumonia.
- Autopsy No. 7—Gunshot of the elbow, haemorrhage
- Autopsy No. 8—Typhoid fever, perforation, and peritonitis
- Autopsy No. 9—Haemoglobinuric fever
- Autopsy No. 10—Paratyphoid fever, abscess of spleen, peritonitis
- Autopsy No. 11—Gastric ulcer, perforation, and peritonitis
- Autopsy No. 12—Meningitis, chronic adhesive. Cavity lower lobe, right lung.
- Autopsy No. 13—Fracture of the skull. Peri-renal haemorrhage, right.
- Autopsy No. 14—Crushing injuries of skull and jaws

The observation of 2 cases of carcinoma in our Haitian laborers is rather interesting; the specimens from both cases were examined by Dr. F. B. Mallory. The case of cancer of the stomach was found in a Haitian negro, aged 47 years. The case of cancer of the liver occurred in a Haitian 29 years of age; this case had been clinically considered as syphilis. The case of liver abscesses was not the result of an amoebic infection. I think it was of cholangitic origin. Autopsy Number 12 was an old Haitian negro who had been frequently treated for syphilis and epilepsy. He died in a status epilepticus. The Meinicke test was strongly positive for syphilis. Flat, thick, hard fibrous adhesions involving the meninges and superficial cortical layers of the frontal lobe (left) were found. This mass formed a lesion about the size of one's palm. There were many old scars in the lungs, pleurae, and liver. A small cavity was found in the lower lobe of the right lung.

WASSERMANN, KAHN, AND MEINICKE (M.T.R.) REACTIONS IN CARAATE

J. C. REGISTER, *Technician*

From the Laboratory Service of Santa Marta Hospital, Santa Marta, Colombia

A report was published in the year 1926 by Dr. Walter Menk* on the positive reactions of the Wassermann test found associated with the various diseases in his hospital and dispensary service at Santa Marta. The high rate of positive reactions found associated with the skin disease popularly known as caraate (pinta) was most astonishing. He tested 67 cases and found 69.5 per cent strongly positive. In view of the fact that the patients tested were undergoing treatment in the hospital and dispensary services for diseases other than caraate, it was desired by Dr. H. C. Clark that we test a series of cases of caraate that were otherwise apparently healthy and that were not under treatment for any cause (though some of them probably had latent malaria and intestinal parasites). None of them complained of any illness and all were engaged in their normal daily duties.

I visited the homes of these people to collect the sera for the tests. The 207 individuals who compose this series were people who had caraate in its various stages, with the blue, black, red, and white lesions, occurring either alone or in some combination. The Wassermann test was applied to all of the 207 cases, the Kahn test to 117, and the Meinicke test (M.T.R.) to 148 of them.

TABLE I
COMPARATIVE REACTIONS OF THE THREE TESTS IN CARAATE

Tests Applied	Number Cases Tested	Per Cent Strongly Positive	Per Cent Weakly Positive	Per Cent Very Slightly Positive	Per Cent Cases Negative	Per Cent of Tests That Could Not Be Read
Wassermann . . .	207	80.6	4.8	2.8	6.7	3.3
Kahn	117	81.1	5.9	5.1	7.6	0.0
Meinicke (M.T.R.)	148	74.4	5.4	5.4	11.4	3.3

Ten children ranging from 6 to 11 years of age were included in this series. All of them revealed strongly positive reactions to the three tests. It can be seen from the table that all of these tests yielded an extremely high rate of strongly positive reactions. They show a rate higher than in the series of hospital and dispensary cases reported by Dr. Menk.

*Walter Menk, M.D., "The Percentages of Positive Wassermann Reactions Found Associated with Various Diseases," *Fifteenth An. Rept., Med. Dept., United Fruit Co., 1926*, pp. 168-170

EDITOR'S NOTE

The state of our knowledge concerning the etiology of caraate is not entirely satisfactory; yet we are not convinced by these high rates of strongly positive reactions that the disease is a peculiar manifestation of syphilis. It is known that caraate, or pinta, is practically limited to tropical America, and that it is extremely common in Colombia. Syphilis, as well as the same races of people, is found in other Caribbean areas, yet the incidence of caraate is low. The fact that mercury and potassium iodide are to some extent effective in the treatment of caraate is by no means conclusive evidence of its relationship to syphilis, because these drugs are curative in mycotic diseases of the skin, and also in a number of diseases caused by various kinds of spirochaetes. None of these serologic tests can be considered as biologically specific. Many report what they believe to be false positives in framboesia, leprosy, malaria, relapsing fever, trypanosomiasis, etc., and it is within the realm of possibility that caraate belongs in this class. It is extremely interesting to learn and record the contents of this report, and to add this information to that reported by Dr. Menk in 1926.

CONDENSED SUMMARY OF THE LABORATORY WORK DONE IN
TELA RAILROAD COMPANY HOSPITAL DURING 1927

JAMES C. McDANIEL, *Technician*

The volume of work conducted in this laboratory during the year shows a considerable increase over that of the previous year. We find an increase of 40 per cent in the number of examinations for syphilis. We have done respectively 32 per cent more blood-film examinations and 20 per cent more stool-examinations. Other work has increased in proportion. It is also worthy of note that the percentage of positive findings for syphilis with the Kahn precipitin test, in comparison with that of the previous year, has been the same. During the year 1926 we conducted 1,971 Kahn tests on blood specimens, with 22 per cent of positive findings, while for this year (1927) we did 3,257 such tests with again 22 per cent of positive findings.

As a result of a case of diphtheria admitted to this hospital in the early part of the year, an investigation of throat lesions has been carried out. Cultures on 145 people revealed 10 positive for *B. diphtheriae*. Diphtheria had been almost non-existent in this area. Very few calls had ever been made on the laboratory to take throat cultures. An interesting article on the Schick Test was forwarded from this division in 1926 by Dr. Taliaferro.*

*See Fifteenth An. Med. Rept., United Fruit Co., 1926, p. 183

POST-MORTEM SUMMARY, WITH COMMENTS ON SOME OF THE MOST INTERESTING FEATURES

WALTER JANTZEN, M.D.

Truxillo Railroad Company Hospital, Puerto Castilla, Honduras

During the year 1927, 97 deaths occurred in this hospital and 45 autopsies were performed. Of the 21 deaths occurring from lobar pneumonia 11 came to autopsy; 3 or more lobes of the lung were involved in 6 of them. With the exception of one case, all were pneumococcus infections. The exception showed a bacillus, which morphologically resembled *Bacillus influenza*. Purulent pericarditis or pleuritis, or both processes, were present in 8 cases, and pulmonary abscess in 2 cases. In 2 cases the descending colon and rectum were covered with a greenish-gray membrane. All pneumonia deaths, with the exception of two, who were of mixed negroid races, were Latin-Americans. Pneumococcus meningitis was recorded as the cause of death twice, in one instance associated with extensive tubercular involvement of the mediastinal and mesenteric glands.

Five autopsies revealed pulmonary tuberculosis as the cause of death. In 2 of them, there was also extensive "cheesy" degeneration of the mediastinal and mesenteric glands. Two were of the miliary type. One of these was admitted to the hospital on May 8, 1927, with a temperature of 102° F., pulse 100, and respiration 24. A thick-blood film examination revealed *E. A. malaria*. Physical examination showed an enlarged, palpable, tender spleen, and tenderness over the gall-bladder region of the liver. The heart was normal; the lungs were normal except for harsh breath sounds over the left axilla. The temperature had subsided to 99.5° F. on the morning of the 9th, but it rose again to 104° F. at midday, accompanied by vomiting. Following an intramuscular injection of quinine, grs. xv, the temperature dropped to normal and fluctuated between normal and 99.5° F. for a period of 9 days, during which time the patient was feeling well and walking about in the ward. On May 18, he suddenly developed severe chills, followed by a temperature of 107° F., convulsions, and delirium, death occurring two hours later.

The autopsy revealed general miliary tuberculosis of all organs as the cause of death. The probable primary focal lesions were large caseous masses in some of the mediastinal and mesenteric glands; there was also a tuberculous ulceration in the caecum.

Acute toxic nephritis (cloudy swelling) is often an accessory finding at post-mortem, while *acute or chronic nephritis* as a cause of death was rather rare. One autopsy revealed chronic nephritis, with dilation of the heart and hypostatic pneumonia as the cause of death. This was a male Honduran, aged 65 years, who died of uremia.

An advanced case of *cystic degeneration* of both kidneys with pyonephrosis (ascending infection) in a negro man, aged 87 years, came to autopsy. Clinically this case was seen as a remarkably severe attack of haematuria.

Two babies came to autopsy—one dying with enteritis, and one with septicaemia.

There was also 1 case of septicaemia following a miscarriage, which revealed perimetritis, salpingitis, verrucous endocarditis, nephritis, broncho-pneumonia and liver cirrhosis (Laënnec type).

Malaria was 4 times recorded at autopsy as the cause of death, though spleens of various degrees of enlargement were present and malaria pigment was found in the smears from the spleen and bone marrow in a large percentage of the autopsy cases.

Cerebral malaria was the cause of death in 1 case, and *blackwater fever* (post haemoglobinuric) in 3 cases. The hearts of the latter were flabby and the muscle pale and soft. The urine in all 3 cases was clear; in one only was it positive for haemoglobin.

Cardio-vascular syphilis was the apparent cause of two deaths in patients about 60 years old. *Syphilitic aortitis* was an accessory finding in 3 cases.

Amoebic dysentery was found twice; in one case it was complicated by an amoebic abscess of the liver.

Lymphoblastoma of the superior maxilla, with metastases in the pancreas and kidney, was responsible for the death of a negro, 30 years of age. (See report by Hutchinson page 149).

Primary liver-cell carcinoma with cirrhosis caused the death of a negro, 37 years of age. He was admitted to the hospital with a history of having vomited blood for several days. Physical examination revealed a very well-developed and well-nourished individual. No abnormal conditions could be found to explain his symptoms. The haemoglobin was 80%; the blood tests were negative for malaria and syphilis; the urine was negative; there was no pain or fever. He vomited small amounts of coagulated blood at intervals, and lapsed into a state of unconsciousness 36 hours after admission to the hospital, dying shortly thereafter.

The autopsy revealed a liver weighing 1,600 grams, the surface of which was uneven and nodular and on section showed a few walnut-sized cavities filled with reddish-grey material. The tissues in the region of the gall-bladder were matted together and on section disclosed 2 cavities—one probably the gall-bladder—filled with similar material. The *hepatic duct* was dilated. The *cystic duct* could not be found. The *pancreas* appeared normal. There were haemorrhages into the mucous membrane of the stomach. The veins in the oesophageal and stomach walls were dilated. Both the stomach and the duodenum were partly filled with blood.

The microscopic diagnosis in this case was (a) *old cirrhosis of acute toxic origin*; and (b) *primary liver-cell carcinoma*.

Four deaths from *gunshot wounds* were autopsied. In 2 there were extensive lesions in the abdominal viscera; the other 2 had lesions of the head with extensive destruction of brain tissue, one complicated with brain abscess.

In 3 instances no definite cause of death could be found at autopsy,—the first with an *extensive ascites and splenomegaly*, which was clinically diagnosed as cirrhosis of the liver (Laënnec Type). The autopsy did not confirm the diagnosis, nor were any other pathological changes found to explain the ascites and enlarged spleen. The 2d was a male Honduran, 20 years of age, who had been under treatment for 10 days in the hospital, with no other symptoms than weakness and anaemia; ankylostoma were also present in the stool. The autopsy revealed a *large duodenal ulcer, chronic splenitis, and hyperplasia of the thyroid*. The 3d died 6 days after admission to the hospital, having given a history of 3 weeks' previous illness. While in the hospital he ran a continuous fever of 103° F.; haemoglobin, 50%; red-blood count, 1,800,000; W.B.C., 1,800; lymphocytes, 70%; and polyneutrophils 30%. The blood culture was negative, as were also cultures taken from the spleen and liver at autopsy. Autopsy revealed bronchopneumonia, a rather large spleen, petechial haemorrhages in the pericardium and small intestine, and a marked enlargement of the lymphatic glands near the *porta hepatis*. Sections of the liver, spleen, and lymph nodes showed cloudy swelling; the liver also showed early central necrosis in several lobules. These findings suggested an infection with some specific organism.

COMMENTS

Confirmatory evidence of syphilis was frequently seen at autopsy, and the Wassermann test reveals that a high percentage of syphilitic infection exists among the native laborers. Syphilis of the nervous system, however, must be extremely rare among them, as it is practically never encountered in this hospital. Although malaria and uncinariasis are very common diseases, they are rarely found as the primary cause of death. They are, however, important and common contributory factors and undoubtedly lower the resistance of the native population to other infections.

The large area of lung tissue involved in the lobar pneumonias coming to autopsy was striking, but primary heart failure is rarely responsible for death in these cases. In contrast to this, we find remarkably low resistance in the muscles of the heart of blackwater fever cases, no doubt owing to the profound anaemia caused by hemolysis. I found at autopsy that a large percentage of the deaths in blackwater fever was due to primary heart failure,—acute dilatation of a pale and flabby heart.

NOTES ON A MICROSCOPICAL EQUIPMENT FOR USE IN THE TROPICS

W. M. JAMES, M.D., F.A.C.P.

Chief of Medicine

Herrick Clinic, Panama

The microscope of today, with its accessories, when produced by a reputable maker, is an instrument of precision and perfect in its parts. The testing of lenses, fascinating and useful as this is, no longer need be a necessity for the purchaser. The stands and movements are durable and exact in workmanship. Indeed, about the only factor which causes trouble is lack of knowledge how to use the instrument, and a comprehension of what it can and can not do.

More and more today there is a tendency on the part of physicians to leave the work of the microscope to their technicians and other laboratory assistants. Most of these, and indeed many physicians themselves, have learned the use of the microscope by rule-of-thumb. It is true that stained histological and pathological sections do not require any special microscopic skill in their study, but when working with fresh and unstained material and with the dark field, some elementary knowledge of the art of microscopy is essential if good results are to be obtained, especially with reference to illumination. Most amateurs work with magnifications which are entirely too high, and illumination which is not sufficiently strong.

STAND

The selection of a stand depends entirely on the use to which it will be put. If the instrument is to serve both laboratory and field work, one of the modern portable stands should be chosen. This may be equipped with a mechanical stage, triple nose-piece, and a good condenser, and, so equipped, will handle any but the most critical work, while its portability has an advantage appreciated only by those who have tried to transport the usual type of stand through difficult places. The substage can be fitted also with a dark-field illuminator, and a binocular attachment can be provided for base-laboratory use. If I could have only one microscope, I should certainly select a stand of this type, whether for use in the laboratory or in the field.

If the stand is for use in a base laboratory, it is always wise to select one of the better models. This should be equipped with interchangeable monocular and binocular tubes. For use in the Tropics, the undetachable binocular should not be considered. While the binocular is coming more and more into favor, and justly so in damp climates a certain amount of mould accumulates on the

prisms, and some types of binocular tube must be returned to the makers for cleaning, during which time, or in case of accident to the binocular arrangement, the monocular tube may be substituted. In Panama, I find it necessary to return one of my binocular tubes about every six months, and so I keep an extra one at the Agent's and notify him when to forward it to me. There is, however, no reason why these tubes should not be made so the prisms may be cleaned as readily as eye-pieces, and I believe one of the British manufacturers does make such a tube.

Where protracted work must be accomplished, such, for instance, as looking through a large number of stools or thick films in surveys, the saving of eye-strain by the binocular is worth all of its extra cost. Nor is there any loss in definition, as some urge. For some years, I have made careful comparisons between the binocular and monocular tubes on the most difficult test objects, and the resolution and definition with the former are in every way equal to those of the latter, and in some respects they are better, particularly in low-power work. There is a perceptible loss of light with the binocular, especially with higher powers, but this is readily compensated by increasing the intensity of the illumination, and seldom is noticed except in working with immersion lenses and high-power eye-pieces.

One great fault in the leading makes of American and Continental stands is the lack of a centering apparatus for the substage, except in expensive research models or when especially ordered. This should not be. In the lower-priced British models, there are adequate facilities for centering the condenser and other substage accessories, and such facilities should be insisted upon by purchasers of even the simpler types of stand. More than one poor performance is due simply to dark or light field condensers being off center.

The dark field is coming more and more into daily use for practical purposes. The dark-field condenser should be easily attached, centered and removed, and there is no excuse today for the elaborate and clumsy models supplied by some makers. Nor is there any need for a special stand and illuminator devoted solely to dark-field work. On three of my stands, the condensers can be readily changed in a few minutes. Two of these stands are expensive research models, but the third is a moderately-priced Continental stand, and serves equally as well for this purpose as do those higher priced. If research work is to be considered, the substage should be arranged for oblique illumination, and in any case it should be provided with a rack and pinion, an iris diaphragm, and a stop carrier. If insisted upon, all of these can be provided for in the larger portable models.

OBJECTIVES AND EYE-PIECES

It is a prevalent, but much mistaken, conception among many users of the microscope, that the higher the magnification, the easier it is to see fine detail. As a rule, total magnification is obtained by multiplying the initial magnifica-

tion of the objective by that of the eye-piece at a given tube length. Magnification is often confused with resolution, which is that quality of the objective by which detail is defined. In a limited contribution such as this, I cannot discuss the subject, but it is generally explained in the makers' catalogues or in the instruction books which should accompany each microscope when sold. The difference between magnification and resolution must be thoroughly understood if one is to have the barest grasp of the essentials of microscopy. Suffice it to say that no amount of magnification will show detail that has not first been resolved, although it may show it more clearly, and frequently does so, when resolution has been effected. Resolution depends upon the numerical aperture (N.A.) of the objective, and is in direct proportion to it, so that, other conditions being equal, an objective of 0.60 N.A. will resolve twice as many lines to the inch as will one of 0.30 N.A. Roughly speaking, with proper illumination by direct white light and the iris diaphragm contracted to the margin of the field of the back lens, a good objective will resolve about its N.A. \times 70,000 lines to the inch, and with oblique white light, about its N.A. \times 95,000. This latter is rarely used in medical and biological work, and for most purposes it will serve to calculate in values of N.A. \times 70,000 in determining the resolution desired. Total magnification should not be carried further than the N.A. \times 1,000 and for routine work, the N.A. \times 500 is amply sufficient.

The standard set of objectives is generally composed of what are called the low dry power, two-thirds, or 16 mm.; the high dry, one-sixth, or 4 mm.; and the one-twelfth, oil immersion, or 1.9-2 mm. With these are furnished two eye-pieces, with magnifications of 5x and 10x respectively. These give total magnifications of from 50 to 900, and resolution of from 18,000 to between 87,500 and 93,000 lines per inch, amply sufficient for all practical needs.

For use in tropical work, however, I should like to suggest some other combinations. Several writers, particularly the late Dr. Spitta, Mr. Conrad Beck and Dr. Coles, have also outlined similar combinations. The 16 mm., or two-thirds, is too high a power for survey work in looking for helminth infections. Nearly all, if not all, helminth eggs can be plainly seen with a 24 mm., or one-inch objective, or even with a 32 mm., objective and a 5x eye-piece. With such combinations, the field is considerably larger, and much time is saved. With a 10x or 15x eye-piece, detail may be clearly seen. These combinations are also very useful in orienting tissue sections. They should be used without a substage condenser, and with the concave mirror.

An extremely useful lens, and one but little appreciated except by experts, is the 8 mm., or one-third. This has an initial magnification of 20, and an N.A. of from 60 to 65. The latter should be obtained whenever possible, but has the disadvantage of coming mostly in the apochromatic series, and so necessitating the use of the more expensive compensating eye-pieces. But so used, the results are most satisfactory. With a low-power eye-piece, it will do the work of a 16 mm. objective, and with eye-pieces of 10x and 15x, it will show as much

as will the ordinary 4 mm., or one-sixth. Its N.A. is as high as that obtained in practice with a 4 mm. of 0.85 N.A., since this latter objective can be rarely used at full aperture. With a properly cut stop in the substage stop carrier and suitable illumination, it gives with a good condenser an excellent dark field, without the necessity of changing condensers. With such a combination, even by using a 5x eye-piece, spirochaetae can be found in fluids, and with eye-pieces from 10x to 5x, their detail can be made out clearly. In these days, fresh preparations are rarely used in the diagnosis of malaria, but the parasites are more readily found in fresh preparations by the dark field than otherwise, and an 8 mm. objective of 0.60 N.A. or more with a 10x or 15x eye-piece picks them up very nicely.

But whatever may be thought of the use of the combinations above suggested, I am convinced that the 3mm., or one-tenth oil-immersion objective is much more useful in every way than the usually supplied 1.9-2 mm., or one-twelfth. It has an initial magnification of about 72, and an N.A. of 1.30, which is ample for the most critical work in medicine or biology. The fluorite objective of this type costs but little more than the achromatic and will stand an eye-piece of 20x or even 25x, and it takes an expert working with specially selected test objects to distinguish its performance from that of the apochromatic, except in photography. And it will work through the thickest No. 2 cover glasses, a great advantage. With a 10x eye-piece, one can see practically all there is to be seen. It should be purchased with a funnel stop, so that it can be used for high-power dark-field work, although this reduces the resolution, and there is a better combination for such work, as will be presently pointed out. In the apochromatic type, with a 1.40 N.A., it is preferred by most experts to the 2 mm. of the same aperture, on account of its greater stability and longer working distance.

An extremely useful, but little known objective is the one-seventh, or 3.5-4 mm. oil immersion. This has an initial magnifying power of about 60, and the fluorite type will stand an eye-piece of 25x. Its N.A. is 0.95, and it can be used without funnel stops in dark-field work, where its performance is decidedly superior to the higher-powered oil-immersion lenses whose apertures have been cut down by funnel stops or otherwise. With blood films and other stained smears, it will show practically all that is necessary, and its relatively large field is very useful in searching and in survey work. It should be remembered that when the condenser is not joined to the slide with immersion oil, no objective, no matter how high its N.A., will give a working N.A. of more than 1. For several years I have used a lens of this type almost exclusively in my routine work on stained smears, reserving my higher powers for special uses. This lens is being made today with an iris diaphragm between its components. It has a full aperture of 1.01, and, with a slight turn of the diaphragm, can be used for dark-field work.

The high dry, one-sixth or 4 mm. objective, usually supplied, has an N.A. of 0.85. This is too high for routine work with either fresh or stained preparations. At full aperture, the glare obscures the object, and the iris diaphragm

has to be closed until the N.A. is reduced to about 0.60. Obviously there is no advantage in this, and today most makers supply what is called a histological one-sixth with 0.65 N.A., corrected especially for use with stained specimens. This objective has a long working distance, and considerably more of what is called depth of penetration than has the 0.85. Theoretically, this type of lens is condemned by experts and in most books on microscopy, but practically it is an extremely useful objective, and except for slight color fringes, works equally as well for fresh material. Even with diatoms, it will give excellent performances, while with stained material, such as tissue sections, its work is admirable. The 0.85 4 mm. objective is very susceptible to variations in cover-glass thickness, and will not perform well unless adjusted to the thickness for which it was originally corrected; and requires special illumination. This is seen particularly when working with fresh material.

The cost of fluorite objectives, as noted, is but slightly more than that of achromatics, and the fluorite type should be selected when possible, especially when there is much fresh material to be examined, and where the dark field is used routinely. With a color screen, they do admirably in photography as well, and they are very durable. Apochromatic objectives are all that is claimed for them, but they are a luxury, and not a necessity.

ILLUMINATION

Few users of the microscope recognize the importance of proper illumination. Any source of light that will show them their material is regarded as suitable.

The selection of a proper illuminant depends entirely upon the class of work to be done. My personal experience is that most trouble comes when the source of light is not properly managed. Light from the usual electric-light bulb, even when frosted, is not suitable without modification. A thin piece of Corning daylight glass, ground on one side, will give admirable results, especially if the condenser is racked down somewhat.

The best sources of light, such as the Pointolight, and the tungsten band filament, require special lamps, and rheostats or transformers, and must be centered and adjusted very accurately. They do indeed give most admirable performances, and a very bright source of light is highly desirable, but they are clumsy and cannot be transported easily, and for most purposes the ordinary incandescent bulb must be used. This should be frosted, of course, and placed in a box which will exclude light from the eye of the worker.

Oil lamps for microscopes are not produced by American makers or used today where electricity can be obtained, but in places where the electric supply is doubtful or uncertain, a well-made oil lamp will give all the light that is necessary, and is preferred by more than one expert for all purposes. They should be specially constructed, and can be obtained from the British makers. They should be equipped with a good bull's-eye, and be freely adjustable in every

direction. The ordinary table lamp can be used in an emergency, but it does not give a good light for working.

The personal equation enters largely into the problem of the intensity of illumination, but, as a general rule, it may be said that the untrained microscopist uses too weak a light. Most of the small substage lamps are unsuitable, and the glasses, for day or artificial light, supplied with them are entirely too thick. The Bausch and Lomb Optical Company supply a very thin daylight glass, cut to fit the substage stop carrier, and I have found this the most all-around useful light filter.

The condensers usually supplied with the moderately-priced stand are of the uncorrected Abbe type. They do very well for ordinary illuminating purposes, but can not be used with a substage stop to make a dark field for low powers. The achromatic condenser of 1.30+ N.A. costs but very little more, and should be substituted. As above noted, the substage should be so arranged that the light-field condenser can be easily removed, and a proper centering apparatus is highly desirable.

At the present time, combination light and dark field condensers can be obtained. With a little practice, these work very well, and will be found extremely useful.

SUMMARY

1. For combination field and laboratory work, one of the larger portable stands is recommended. However, in purchasing such a stand, it should be insisted upon that the substage be made so that accessories can be readily interchanged, and a swing-out stop carrier should be provided also. A binocular attachment will be found of great service, but it should be interchangeable, and not attached permanently to the stand.

2. The standard set of objectives, viz., the two-thirds, one-sixth and one-twelfth, will serve all practical purposes. At the same time, it is recommended that the one-tenth fluorite oil immersion be substituted for the one-twelfth. The consideration of the other objectives above referred to is also recommended. Their cost is not great, and they will be found highly useful. The achromatic condenser should be substituted for the ordinary Abbe.

3. The dark-field condenser should be easily and readily interchangeable. And the combination dark and light field condenser will be found highly useful, although this should not be used exclusively in place of the achromatic condenser.

The use of a thin piece of daylight glass, ground on one side, to modify the source of light, is recommended. This should not be too thick. The source of light should be intense rather than weak, modified suitably by proper light filters.

SECTION V

SNAKES FROM THE SANTA MARTA REGION, COLOMBIA

H. C. CLARK, M.D.,

Medical Department, United Fruit Company

The snake census instituted in the Colombia Division of the United Fruit Company is now drawing toward its close, and some information concerning the reptiles of the banana zones can be had by referring to the article above mentioned which appears in the *Bulletin of the Antivenin Institute of America*, (Glenolden, Pa.), Vol. II, No. I, page 7, April, 1928. The total number examined to date from the division is 710 specimens, and the following poisonous species have been identified: ,

Micrurus corallinus dumerilii (Jan), a coral snake

Micrurus mipartitus (Dm. and Bibr.), a coral snake

Bothrops lansbergii (Schlegel), one of the hog-nosed species of vipers

Bothrops atrox (L.), the *fer de lance*, known also as *barba amarilla* and *terciopelo*

Crotalus terrificus (Laurenti), known also as the *cascabela* and rattlesnake

Dr. do Amaral says that from a practical standpoint neither of the coral snakes represented in the collection is dangerous, because they bite in very exceptional cases. In regard to the rattlesnake, he does not think that at present it constitutes a serious problem in the banana zones. The *fer de lance*, which is the main problem in other banana divisions, seems to be comparatively uncommon in Santa Marta, its place being taken by another venomous species, seldom found elsewhere, but surprisingly common in the Colombia division. This is the dry-land hog-nosed viper (*Bothrops lansbergii*), which constituted about 50 per cent of the catch in the Rio Frio District. This species has been found among leaves in dry forests, and also under bushes, dead trees, etc., so that it is anticipated that with the progressive clearing of the jungle it will probably invade the banana plantations, and may become dangerous to the laborers in that section. It is interesting to note that in the Rio Frio District the incidence of these poison species was as follows:

Bothrops lansbergii (Schlegel), 343 specimens

Micrurus corallinus dumerilii (Jan), 33 specimens

Bothrops atrox (L.), 19 specimens

Crotalus terrificus (Laurenti), 5 specimens

Micrurus mipartitus (Dm. and Bibr.), 1 specimen

These results are largely confirmed by the work of A. G. Ruthven in 1913 and 1920. His expeditions were made in the region of Santa Marta, for the University of Michigan. His reports can be found in the paper, "The Am-

phibians and Reptiles of the Sierra Nevada de Santa Marta, Colombia," in *Miscellaneous Publication No. 8* of the Museum of Zoology of the University of Michigan. Further interesting data on the snakes of this region can be found by referring to Dr. do Amaral's report on the collections made by Dr. E. J. Pampana in the region of the San Juan River, Provincia Choco, in the western part of Colombia (see the *Bulletin of the Antivenin Institute of America*, Vol. II, No. I, April 1928, page 7).

A new coral snake (*Micrurus stewarti* sp.n.) has also been described for Panama by Dr. Thomas Barbour and Dr. Afranio do Amaral. This report can be found in the *Bulletin of the Antivenin Institute of America*, Vol. I, No. 4, January 1928, page 100.

A SNAKE-BITE CASE

SPECIAL REPORT FROM PUERTO CASTILLA, HONDURAS

B. M. PHELPS M.D.

During the past year only one case of snake-bite poisoning has been reported in the division of the Truxillo Railroad Company.

CASE REPORT

Male, Honduranian, aged 48 years. — He was admitted to the hospital at 6.20 P.M., December 11, 1927.

Personal History. — He reported that while he was walking through the fields at Guabul Farm (Black River District) about 60 kilometers from the hospital, just before daylight on December 11, he was bitten on the left foot. He did not see the snake. A few moments afterward he felt sleepy, and yawned frequently, but did not notice any impairment of vision. Two hours after first aid was given him, the foot and leg became swollen and very painful. By 9 A.M. he was vomiting, and expectorating bloody material, and felt very sick.

Physical Examination. — This was made in the hospital twelve hours after the bite. The patient was a heavily built, well-nourished, native. The left foot and lower two thirds of the left leg were greatly swollen, but revealed only slight discoloration. A small incision was found over the mid-dorsal area of the proximal joint of the 2nd left toe, and a similar incision was noted on the dorsum of the left foot at the base of the left, first toe. No fang wounds could be seen, but it was taken for granted that these punctures were near the center of each incision. The incised wounds were very superficial, and were packed with potassium permanganate crystals. The distance between the centers of the 2 wounds was 2 cm. Blood was oozing from the gums. The man had many decayed teeth and a severe pyorrhoea alveolaris. The spleen was enlarged, and extended 3 fingers below the costal margin. The stools contained the ova of uncinaria.

Treatment. — A short time after the man was bitten, the wounds were incised and sucked and black crystals of potassium permanganate were applied. No ligature was applied to the foot or leg. Following the admission of the patient to the hospital, a period of probably twelve hours after the snake-bite, one ampoule of antiothropic serum was administered. The wounds on the left foot were cleaned and dressed, and ice caps were applied. At 10 P.M. of the same day as the accident, the patient had severe cramping pains in the arms and legs. He was given morphine sulphate, grs. $\frac{1}{4}$, by hypodermic administration, and subsequently passed a fairly comfortable night. The following day he felt much better, and all bleeding had ceased. He did complain of pain at the site of the injection of the antivenin. On December 13 the patient was greatly improved. There was no pain and the swelling in the foot had greatly decreased. December 14 the swelling of the foot had disappeared. December 15 he was allowed to get up. December 18 he was discharged as entirely well. The wounds of the foot were healed.

Species of Snake Responsible for Accident. — Judging from the distance between the estimated locations of the fang wounds, the prompt haemorrhage, and the efficacy of the antiothropic serum in checking the haemorrhage, the patient would appear to have been struck by a large snake of the viper type, probably *B. atrox*. The amount of venom injected by the snake was probably small, since the accident occurred in the early morning hours and the snake had very likely secured a night feeding into which the bulk of its venom had been discharged.

REPORT OF SNAKE-BITE CASES

N. P. MACPHAIL, M.D.

Quirigua Hospital, Guatemala

During the year 1927, there were 8 cases of snake-bite admitted to the hospital. Three cases developed no symptoms and were discharged after a short period of observation. One of the remaining 5 cases died 15 hours after admission.

CASE 1

This accident occurred on a farm over 50 miles from the hospital. The man was admitted in an unconscious state. The snake-bite was located on the left middle finger, which was gangrenous; and dark, bloody fluid was discharging from the fang-puncture wounds. There was also bleeding from all mucous membranes. He died without regaining consciousness.

CASE 2

The case was admitted to the hospital 12 hours after being bitten. He was carried in on a stretcher, in a very weak condition. The bite was located on the calf of the right leg. There was bleeding from the mouth, rectum, and

conjunctivae. Anti-ophidic serum was given, on admission. Considerable tissue-destruction followed, from gangrene and sloughing which involved some of the calf muscles. A large area of the skin was also lost. Skin-grafting was performed. The patient was in the hospital for 4 months, and was discharged with a useful leg. He stated that the snake responsible for the accident was a "*barba amarilla*" (*Bothrops atrox*).

CASE 3

The patient was bitten on the left hand, 24 hours before admission to the hospital. He was in a state of collapse, and blood was oozing freely from the wound, and also from the gums for several days. He was under hospital treatment for 7 weeks, but was discharged well. He stated that the snake responsible for the accident was a "*barba amarilla*" (*Bothrops atrox*). Anti-ophidic serum was given immediately on his admission to the hospital. He also received haemostatic serum and treatment for shock.

CASE 4

This patient was bitten on the right leg, 18 hours before admission to the hospital. He was brought in on a stretcher, in a state of collapse. There was bleeding from all mucous membranes. There was quick response to anti-ophidic serum treatment, and the patient was discharged on the 7th day following his admission. He did not know the kind of snake that bit him.

CASE 5

He was admitted to the hospital 5 hours after being bitten on the calf of the left leg. The bite wound was incised and cauterized, but it continued to bleed profusely for some time. The day following his admission, he passed large bloody stools. He was under treatment for 19 days, and was discharged in good condition.

CASES OF SNAKE-BITE TREATED IN ALMIRANTE HOSPITAL PANAMA, DURING THE YEAR 1927

R. L. CARROLL, M.D.

We treated a series of ten cases during the year. There were no deaths. The cases are briefly reported as follows:

CASE 1

History.—A man aged 51 years was bitten 4½ hours before admission to the hospital. The location of the bite was on the dorsal surface of the right foot, and the puncture wounds were 1 inch apart. There was immediately intense pain at the site of the bite. Bleeding from the gums was noted 3 hours later. The foot and leg soon became swollen, and later in the area of the fang punctures an abscess formed.

Treatment.—Ten cc. of polyvalent antivenin were given intravenously on the day of admission, and repeated on the 4th day following. The abscess mentioned above was opened about one week after the accident occurred; Marked sloughing about the incisions followed. The patient remained in the hospital 139 days.

Snake Responsible for Accident.—The snake was described as *Bothrops atrox*.

CASE 2

History.—A woman aged 33 years was bitten on the right foot 3 days before admission. Bleeding from the nose and gums occurred and the pulse was weak and rapid. She remained for 11 days in the hospital.

Treatment.—Twenty cc. of polyvalent antivenin were given intravenously.

Snake Responsible for Accident.—Unknown.

CASE 3

Case History.—A 7-year old girl was admitted 3 hours after the accident. The location of the bite was not recorded; and the only symptom recorded was a rapid pulse. She remained in the hospital for 9 days.

Treatment.—Ten cc. of polyvalent antivenin were given intravenously.

Note.—This case also had malarial fever, which accounts for the duration of the hospital stay.

Snake Responsible for Accident.—Unknown.

CASE 4

History.—A man, aged 44 years, was admitted 18 hours after the snake-bite had occurred. The location of the bite was recorded as on the dorsum of the right foot. Pain was felt at the site of the bite in a few minutes. There were weakness and faintness, and the foot and ankle began to swell. On the 2nd day there were pain and cramps in the abdomen, but no rigidity of the abdominal wall. Nausea and vomiting were noted. On the 3d day the patient expectorated bright-red blood, which did not clot. The gums bled profusely, and bloody fluid oozed from the fang punctures. At 8 P.M. on the 3rd day, following intravenous administration of antivenin, the patient was improved and the bleeding from the gums ceased. This patient remained in the hospital 21 days.

Treatment.—Ten cc. of polyvalent antivenin was administered intravenously on the 2nd day after the accident.

Snake Responsible for Accident.—Unknown.

CASE 5

Case History.—A man, aged 33 years, was admitted 5 hours after the accident. The location of the bite was on the right knee. The early symptoms were dizziness, dimness of vision, nausea, and vomiting. He remained in the hospital 5 days.

Treatment.—The wound was incised 2 hours after the snake-bite occurred, and crystals of potassium permanganate were applied. Five hours after the accident, 10 cc. antithroptic antivenin were administered intravenously.

Snake Responsible for Accident.—Unknown.

CASE 6

History.—A man, aged 39 years, was admitted 2 hours after being bitten. The location of the bite was on the flexor surface of the right forearm. The chief symptoms were oozing of blood from the fang punctures and slight swelling about the site of the bite. The man remained in the hospital 5 days.

Treatment.—He was given 10 cc. of polyvalent antivenin intravenously.

Snake Responsible for Accident.—Unknown.

CASE 7

History.—A man, aged 42 years, was admitted 4 hours after the accident. The location of the bite was on the distal phalanx of the left, middle finger. There was oozing of blood from the fang puncture wounds. The patient remained under hospital care for 5 days.

Treatment.—He was given 10 cc. of antithrotophic antivenin intravenously.

SNAKE RESPONSIBLE FOR ACCIDENT.—Unknown.

CASE 8

History.—A man, aged 42 years, was admitted 3 hours after the accident. The location of the bite was on the middle phalanx of the right ring finger. Slight swelling developed about the fang punctures, but no nausea or bleeding occurred. He remained in the hospital 5 days.

Treatment.—He was given 10 cc. of antithrotophic antivenin intravenously.

SNAKE RESPONSIBLE FOR ACCIDENT.—*Bothrops schlegelii*.

CASE 9

History.—A man, aged 38 years, was admitted 4 hours after the accident. The location of the bite was on the left, middle finger. There were 2 fang-puncture wounds, but no swelling developed and there were no toxic manifestations even 10 hours after the accident. He was discharged 4 days after his admission.

Treatment.—No antivenin was used. Local treatment of the wound was given.

SNAKE RESPONSIBLE FOR ACCIDENT.—Unknown.

CASE 10

History.—A man, aged 29 years, was admitted 4 hours after the accident. The location of the bite was on the right leg, 10 cm. above the outer surface of the ankle. There was an oblique fang wound of the skin, but no oozing of blood from the wound. No nausea, vomiting, nor dimness of vision occurred. Bleeding from the gums was noted, and there was numbness of the leg 1 hour after the bite occurred. There was pain in the leg after the serum was given, and also during the following day. The patient was still bleeding from the gums before the 2nd injection of antivenin. He was greatly improved on the 3rd day. Slight ulceration occurred in a zone of about 5 mm. about the fang wound. He remained in the hospital 9 days.

Treatment.—He was given 10 cc. of antithrotophic antivenin on admission, and this dose was repeated 6 hours later. The method of administration was intravenous.

SNAKE RESPONSIBLE FOR ACCIDENT.—The snake was described as a short buff-colored one. It was not killed.

NOTE

It is interesting to observe that apparently no ligature was used in any of the cases. It is unfortunate that we have no information regarding the snakes that were responsible for these accidents, with the exception of three cases. It would appear probable that the buff-colored, short snake reported in Case No. 10 was the horned palm viper (*Bothrops schlegelii*). Specimens of this snake that are yellow in color are not uncommonly captured in Central America.

All initial treatments with antivenin were given immediately after the admission of the cases to the hospital. Case No. 9 received none. Some of these cases appear to have been bitten by non-poisonous species or by poisonous snakes whose glands were practically empty at the time they bit the patient.

It is hoped that the inhabitants of our divisions can be educated in the subject of snake-bite sufficiently to enlist their help in capturing snakes responsible for bites. All such specimens, with an abstract of the case history should be forwarded to Dr. Thomas Barbour, of the Museum of Comparative Zoology, Harvard University, Cambridge, Mass., for scientific identification and record.

THE UNITED FRUIT COMPANY'S COOPERATIVE ACTION IN THE DEVELOPMENT OF ANTIVENINS*

H. C. CLARK, M.D.

Medical Department, United Fruit Company

The snake-bite problem in the coastal regions of Central America and on the north coast of South America is a subject of importance to the Medical Department of the United Fruit Company, since many of its plantations are located in those countries.

Our old medical records probably do not correctly reflect the incidence of snake-bite accidents on the plantations, for the following reasons:

(1) The person bitten is usually at a remote distance from the hospital or one of the dispensaries at the time of the accident. He may either recover or die before he can reach lines of communication that can transport him promptly to a hospital.

(2) Many snake-bite accidents are not followed by serious results. The victim may not have been bitten by one of the dangerous species or, if so, the mechanical features concerned with the act of biting may not have resulted in the injection of a serious dose of venom.

(3) It has not been possible, until recently, to procure a specific antivenin that could be sent to remote, hazardous areas and be expected to maintain its effectiveness without being preserved by refrigeration. The local *curanderos*, or snake-doctors, in such localities there have had an opportunity to learn more about the true incidence of snake-bites than the staffs in our medical centers.

Scarcity of Reliable Data. — Fragmentary records concerning the snakes of Central America and snake-bite accidents have been slowly accumulating for many years; but no scientific knowledge, based on large collections of snakes or on carefully recorded histories of snake-bite poisoning in those regions, has been obtainable. Some data are available on the species of snakes to be found in Colombia, Panama, and Costa Rica, but the general public and the general

* For the convenience of the reader, this article summarizes parts of the articles on this subject appearing in the 1925 and 1926 Annual Reports of the Medical Department of the United Fruit Company.

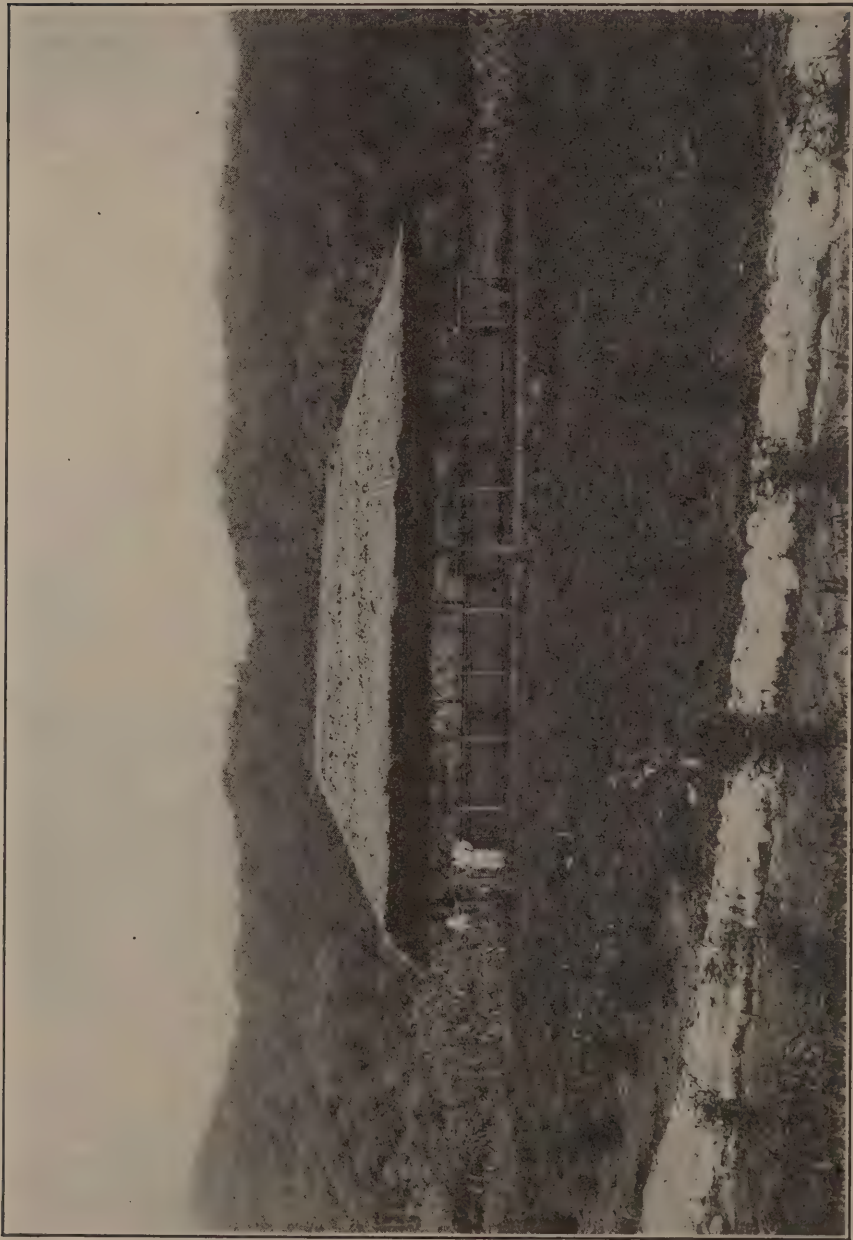


FIG. 1. EXTERIOR OF THE SNAKE PIT AT THE TELA SERPENTARIUM
The snakes that supply the venom for the manufacture of our local antivenins are kept in this pit.

medical profession in all the tropical countries north of Brazil have little accurate information concerning their local poisonous species. The result is, that a dangerous snake common to all these countries may have a different local name in each country while its true species remains unknown.

It is usually very difficult to obtain reliable information relative to snake-bite accidents, as the individual bitten and his companions seldom realize the importance of capturing the snake in order that it may be identified. It is, however, very important for the physician in charge of the case to know the exact species that caused the accident, in order that he may select the specific antivenin required for treatment. Unnecessary suffering and occasional deaths have occurred each year on some of the plantations, although snake-bite accidents have never occupied a high rank in our statistics relating to the various forms of external violence. It must be admitted, nevertheless, that many such accidents in the past have never been reported to the Medical Department, since the natives have possessed little faith in hospital treatment for snake-bite poisoning. Antivenins prepared for use against the Old-World species of snakes have had little or no effect against our local species, and even antivenins prepared in Brazil can be of little assistance to us without a knowledge of our poisonous species.

Plan of Procedure.—The New World, with the exception of Brazil, has never considered the snake-bite question sufficiently important, until recently, to demand the production of antivenin on a commercial scale. In spite of the fact that Mitchell¹ built the foundation of our modern knowledge of snake venom and its active principles in the period 1860 to 1886, and that Flexner² and Noguchi³ succeeded in preparing certain specific antivenins in 1902, we have found ourselves until quite recently with no constant source of supply of specific antivenins for protection against the dangerous species in Central America, on the north coast of South America, and in the United States. The antivenin institutes of Brazil are not in a position to assure us of a constant supply, since they experience some difficulty in providing sufficient amounts even for their local requirements. Our physicians have found themselves confronted with two important obstacles in their efforts to cope with snakebite accidents:

- (1) A lack of scientific knowledge of the dangerous species of snakes in their immediate localities
- (2) Absence of a constant source of supply for specific antivenins

We were forced, therefore, to arrange for a census of the snakes on the banana plantations of the Company, except in Cuba and Jamaica, where no dangerous species exist. Dr. Vital Brazil in 1923 first offered to cooperate in this matter; but his duties in Brazil, and the great length of time required to carry out his plan, made this arrangement appear impracticable. In March, 1924, I was very fortunate in receiving a visit at Tela, Honduras, from Dr. Thomas Barbour, who was en route to the United States from a visit through Central America



FIG. 2. INTERIOR OF THE SNAKE PIT, SHOWING THE HUTS WHICH AFFORD A REFUGE FOR THE SNAKES. These huts are of light material and are easily moved about. One section of the roof is removable, thus making it safe to inspect the interior of the hut and expedite the capture of any snake wanted. The floor of the pit is sand. Water is supplied by a tank sunk into the sand floor.

and the West Indies. I discussed with him the desire of the General Manager of our Medical Department to obtain more definite knowledge concerning our poisonous snakes, and he at once proposed a scheme of cooperation between the Museum of Comparative Zoology at Harvard University, and the United Fruit Company. This plan was to include a general census of all snakes; the United Fruit Company to collect the specimens and transport them to the Museum of Comparative Zoology at Cambridge, Massachusetts, where Dr. Barbour and his staff would conduct the work of identification and enumeration.

The north coast of Honduras and Guatemala is largely given over to the cultivation of fruit and, as the Tela Railroad Company is centrally located on this coast, we concentrated our efforts, in the snake census, upon the plantations of this company. We spent several months in a fruitless effort to collect specimens without paying a bounty. An arrangement was then made between the Tela Railroad Company and Dr. Thomas Barbour that enabled us to offer a bounty of twenty-five cents a head for all snake specimens, irrespective of the size or kind of snake captured. This method stimulated the labor forces on all these plantations to make a uniform collection of all the snakes they could find during the period of their day's work.

Collection Area.—Tela, Honduras, C.A., is the port town of the division, and its geographical position is $15^{\circ}, 46', 30''$ north latitude and $87^{\circ}, 27', 30''$ west longitude. The division lies on the north coastal plain of Honduras, and the approximate area from which the snakes were collected is 50,000 acres. The collection was in progress while 2,500 acres of this region were being cleared of its primitive jungle growth and planted in bananas. The remainder of the region where the collection was made, was fruit-bearing land. All of this banana development represents virgin soil,—the initial clearing of the jungle. The average elevation of the region is 50 feet above sea level, the range being from 5 to 200 feet. The land lies between the south bank of the Ulua River and the north bank of the Lean River. Our collection was therefore a lowland census, and does not reflect the character of the snake species that may exist in the highlands.

Period of Census.—The work began in July, 1924, and ended in October, 1925. Catches were small in the *dry season*. During this season the plantations are not cleared, in order that grass, bushes, vines, etc., may become abundant and help to retain moisture in the soil. We were thus deprived, during this period, of the valuable catches made by the "cleaning gangs," who caught the larger proportion of the specimens included in the total collection.

Result of Census.—Dr. Barbour⁴ reported on 3,349 specimens, which contained 31 species of harmless snakes (2,746 specimens) and 4 species of poisonous snakes (603 specimens); and of the 603 poisonous specimens, 352 were the dreaded *fer-de-lance* (*B. atrox*). This species was far more common on the older banana farms than on the new farms just being cleared and planted—probably owing to the multiplication, on the old farms, of rodent life, which supplies the food

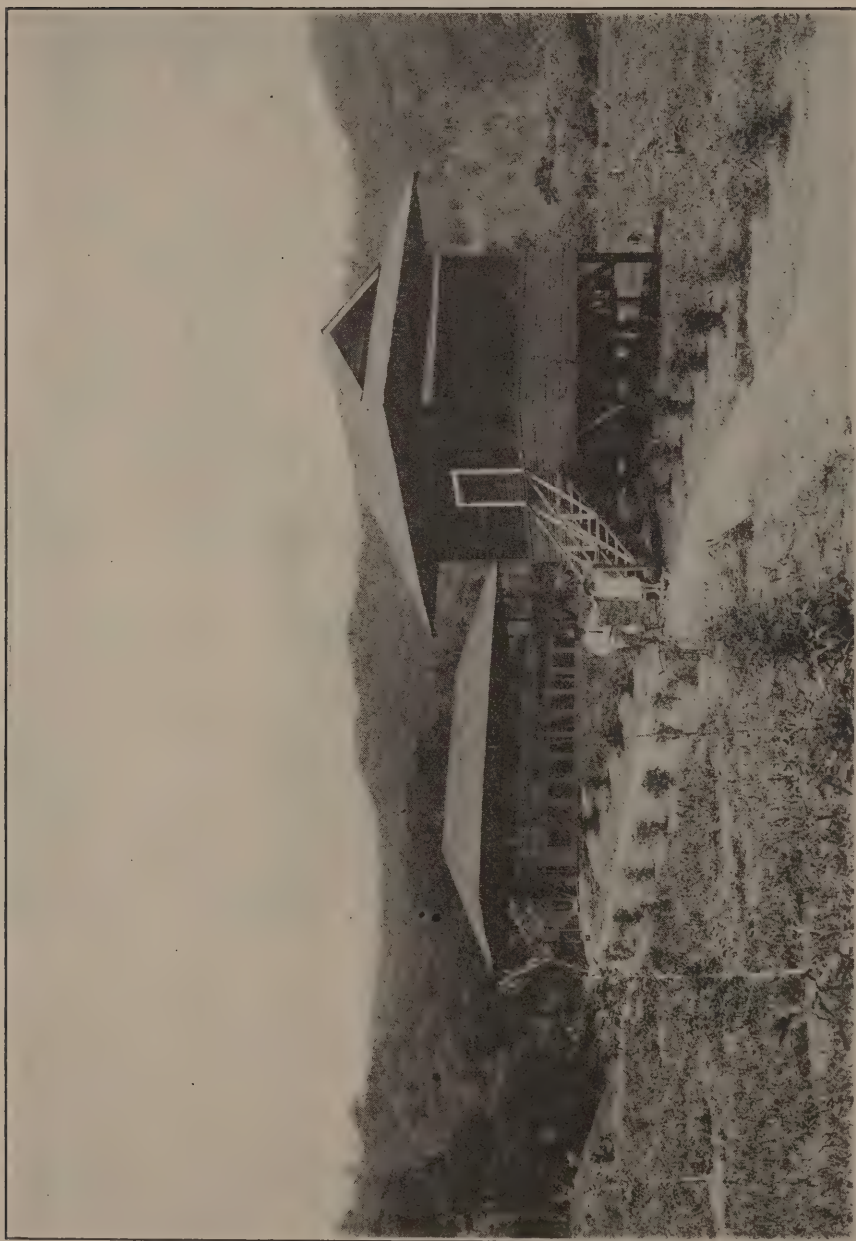


FIG. 3. OBSERVATION BUILDING AT THE LEFT, AND LABORATORY AT THE RIGHT
The feeding and other habits of snakes are studied in the former building, while the laboratory serves as a safe place in which to extract venom, and pursue other lines of work.

for this snake. The census, together with recorded zoological information concerning Colombia,⁵ Costa Rica⁶ and Panama⁷, seems to cover most of the information we needed about Central-American species. We are adding to the records of Colombia by a census which was completed 1926-1927 and which reveals the presence, even in the lowland, of the rattlesnake and the bushmaster. The former species seems to be abundant. We are now in a position to know the species of poisonous snakes to which the inhabitants of the United Fruit Company's divisions are most liable to be exposed. These species⁸ are:

1. *Bothrops atrox*, generally known as the *fer-de-lance*. It is known, however, in Honduras as the *barba amarilla*, and in Nicaragua and Costa Rica as the *terciopelo*. It is perhaps the most abundant species and one of the most dangerous snakes found in the fruit zones, from Colombia to Mexico. Usually it is found on the ground, but its young have many times been found higher than one's head, in bushes where they seem to have been able to climb by gliding over vines growing through the bushes.
2. *Bothrops schlegelii*, more generally known as the "horned palm viper." It is also known, however, as the *bocaracá*, *toboba de pestanas*, *oropel*, and "sleeping gough." This is a tree or bush snake, and is to be found on all the mainland plantations. It may be green in color, entirely yellow, or plaid-marked. The half-dozen snake-bite accidents due to this snake, that I have seen, have not been attended with dangerous manifestations of poisoning.
3. *Bothrops brachystoma*, the "hog-nosed viper," known also as the *tamaga*. It is a ground snake in its habits. I have known of only one case of snake-bite due to this species. It produced serious results, very similar to those expected from the bite of *B. atrox*.
4. *Lachesis mutus*, generally called the "bushmaster." It also bears other local names, however, peculiar to each country in which it is found. So far as we know at present, it is most common in Colombia and Panama, and usually inhabits the highlands. It is a very dangerous snake.
5. *Crotalus terrificus*, commonly known as the rattle-snake. In all the Central-American countries it bears the vernacular name of "*cascabela*." In Colombia and Panama it is more common than in the other countries where the United Fruit Company operates. It is said to exist in the highland regions from Colombia to Guatemala, but in Colombia it is found in the fruit zone as well. This is a very dangerous snake, and its bite requires a specific antivenin. The antivenins made to counteract the poison of the rattlesnake species of the United States have little effect against the bite of this species.
6. *Micrurus nigrocinctus*, the coral snake. This reptile is common to all the mainland divisions. It seldom bites, because of its burrowing habits and of certain conditions connected with the mechanics of biting. It is, however, a very poisonous species. This snake is also known as the "harlequin snake" and the *gargantilla*.

The capture of the 3,349 snakes included in the Tela collection did not result in a single case of snake-bite, yet during this same period 10 cases of snake-bite were admitted to Tela Hospital. None of these men were bitten by a snake that they were attempting to capture or kill. In fact, they did not know they



FIG. 4. METHOD USED IN EXTRACTING VENOM

The venom is dried and then shipped in a crystalline state to the Mulford Laboratories.

were near a snake until the accident occurred. Two of the men were poisoned seriously enough to need treatment with an antivenin, while the others recovered promptly without this treatment. Our knowledge of the snakes responsible for these accidents is as follows:

<i>Bothrops atrox</i> (identified)	2
<i>Bothrops atrox</i> (suspected)	2
<i>Bothrops schlegelii</i> (identified)	3
<i>Micrurus nigrocinctus</i> (suspected)	1
Unknown kind, but caused symptoms	1
Boa (harmless)	1

The bites were located on the hand, forearm, ankle, or foot in all these cases. These are the locations where such bites usually occur. A very wide range of results may be expected in snake-bite accidents, even if the same species is responsible for the injuries. The prognosis depends not only on the species of snake, but also on the amount of venom in the glands at the time it strikes. Other factors that govern the result are: the mechanism of the bite; and certain accompanying factors such as protective clothing, and a failure of the fangs to penetrate the skin. A snake that has recently killed and ingested its meal will require some time to secrete enough venom to fill its glands again. According to Dr. do Amaral,⁹ it requires about two weeks for a snake to regain its maximum capacity of venom and its maximum degree of toxicity. Nearly all of our dangerous snakes are nocturnal in their habits, and therefore capture their food at night and conceal themselves during the day. Our collection of snakes captured in the daytime, in the Tela census, revealed a high incidence of poisonous reptiles. One wonders what a *night collection* in the same area might have revealed!

No doubt, the habits of these snakes save our labor force from many dangerous accidents. The most serious snake-bite cases that I have seen were caused by baby specimens of the *fer-de-lance* that weighed only 20 grams. These specimens struck men shortly after they had gone to work in the morning. The snakes had not captured a meal during the night, as evidenced by their empty alimentary tracts. Although the quantity of venom injected must have been small, yet it contained a high degree of toxicity. It is encouraging to observe that many of our laborers now understand the importance of killing the snakes responsible for their accidents, and bringing them in for identification. This affords a chance to select the proper antivenin for use in treatment, and frequently also enables us to record some valuable information regarding the snake.

Need for Constant, Reliable Antivenin Supply.—Completion of our snake census left us still facing the problem of securing a constant supply of the specific antivenins we needed for the various plantations. Up to this time (through the courtesy of Dr. Barbour) we had been securing antivenin in small quantities from the institutes located at São Paulo and Nictheroy, Brazil. These were the only places then producing satisfactory antivenins for the bites of the species of snakes indigenous to the Western Hemisphere, and these had been



FIG. 5. MR. DOUGLAS MARCH, SUPERINTENDENT OF THE TELA SERPENTARIUM, EXHIBITING AN ADULT FER-DE-LANCE SPECIMEN

This snake weighed 4.3 pounds (1,950 grms.) and measured 6 feet 7 inches in length (2.006 meters). It is a female specimen that had a litter of 72 young. Of this number, 57 were quite active at the time of their birth, while 15 were stillbirths, probably owing to an injury the mother sustained and to crushing or suffocation by other large snakes in the hut at the time the litter was born.

prepared from and for the particular species of snakes encountered in Brazil. The United Fruit Company does not have a snake problem of sufficient magnitude to warrant the development of its own antivenin laboratories for the manufacture of such sera, but it is sufficiently interested in the subject to cooperate in this work. Our tropical experience, together with investigations conducted in the United States by Ditmars,¹⁰ Barbour,¹¹ and do Amaral,¹¹ revealed evidence that there is now a large enough demand to warrant the commercial production of antivenins. The wonderful progress made in road-construction and automobile-manufacture in the United States has tremendously increased hiking, hunting, fishing, and automobile camping; and these, in their turn, have increased the exposure to snake-bite accidents. The hazards which accompany the development of mines, oil fields, fruit plantations, etc., in the Tropics of Central America and the north coast of South America have also added to such exposure.

There was absolutely no supply of specific antivenins for use in these areas, and the time therefore appeared ripe for some organization to start the commercial production of sera. These facts led to the formation of the association now known as the Antivenin Institute of America,¹² which is a subdivision of the Mulford Biological Laboratories.

The United Fruit Company's cooperation is, of course, directly connected with the Neotropical Section of the Institute. The company has supplied a site and three buildings for a serpentarium at Tela, Honduras; and later, if necessary, it will do a similar thing at Santa Marta, Colombia. At Tela the buildings have already been erected, and will be maintained by the Company. One is utilized as an observation building; a second is the laboratory; and the third is the snake-pit. This plan offers an opportunity to study the habits of snakes in that area and to collect venom, which is dried and then shipped to the subdivision of the Mulford Biological Laboratories, where it is used in the manufacture of specific antivenins. The assistant in charge of the Tela serpentarium is paid in part for his services by the Mulford Biological Laboratories. The United Fruit Company renders assistance in the capture of snakes, and supplies the necessary transportation by its railroads and ships for the personnel and the products of the serpentarium. Quarters, meals, laundry, and other personal needs are also supplied the local director of the station, and in case of illness he will be able to avail himself of the facilities of the Company hospital. Mr. Douglas March took charge of the Tela Station November 13, 1926. Enough venom has been collected and shipped to start the manufacture and distribution of anti-fer-de-lance serum. Some information concerning the breeding habits of this species, as well as some facts about other species of snakes, have been obtained. Additions to the Tela census are constantly being made, and efforts are now under way to ascertain the species of snakes that are to be found in the highland regions of Honduras and Guatemala. It appears reasonably certain that the rattlesnake, and also the bushmaster, will be found.

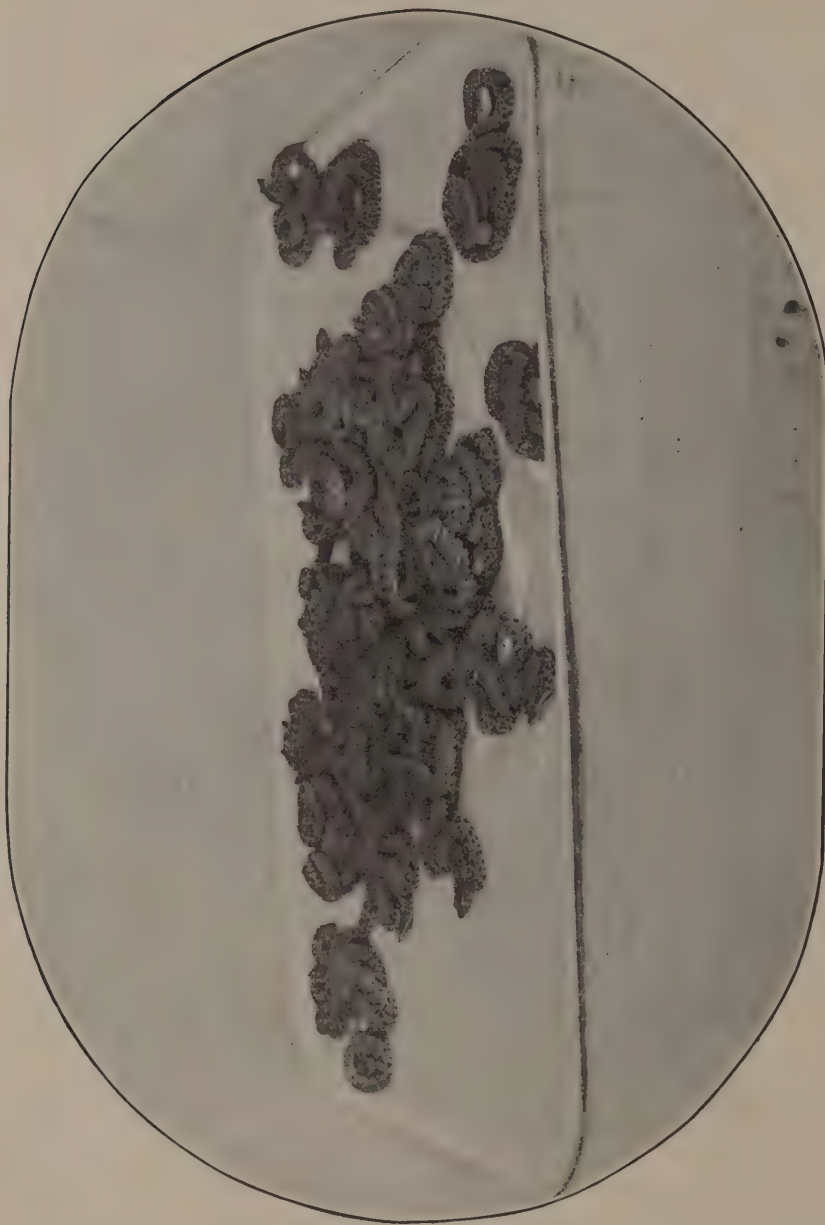


FIG. 6. SOME OF THE LITTER (SEE FIG. 5) ABOUT 48 HOURS AFTER BIRTH
An average active specimen of this litter measured 33 cm. (13 inches) and weighed 10.5 grms. 24 hours after its birth. The total weight of the litter based on this average weight was 756 grms. (1.66 pounds).

The new methods employed in the manufacture of these sera make it possible to concentrate the dose, render it more powerful, and preserve it over a period of 5 years without refrigeration. Furthermore, the new products are marketed in 10 cc. syringes ready for instant use. The antivenins issued have been standardized by the U. S. Public Health Service, and on April 25, 1927 were granted a license which permits the manufacture and the interstate sale of the Nearctic *Crotalidae* Serum. This arrangement now applies to the Neotropical sera also.

Dr. do Amaral¹³ has clearly stated the principal factors which determine the success of these antivenins:

- (1) Early administration
- (2) Mode of administration adapted to the gravity of the case
- (3) Dosage proportional to the quantity of venom inoculated

The United Fruit Company is particularly fortunate in having this opportunity to cooperate with the Antivenin Institute of America. It is the only institution at present in a position to advance a public-health measure that has heretofore been given little attention in the Western Hemisphere, outside of Brazil. There is included, also, an ambitious program for the study of the habits of snakes, which is an important class of information, inasmuch as little is known about their breeding habits and their inability to adapt themselves to new conditions. The success of the organization seems assured, and all companies operating in the Tropics should support the Institute in its efforts to gain all the information possible about serpent life in their respective localities.

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SECTION VI

ORGANIZATION AND VITAL STATISTICS

SCOPE OF MEDICAL DEPARTMENT

Phases of the Work. — The Medical Department functions as regards all conditions pertaining to the prevention of disease and the care of the sick and injured. This work embraces the following phases:

- (a) In the Tropics, care of employees and their dependents; and of the inhabitants of communities within the limits of, or contiguous to, the plantations when no other medical service is available.
- (b) On all the Company's steamships, care of passengers and members of the crews.
- (c) In the Domestic Divisions where the Company maintains medical staffs, dispensary service to employees.
- (d) Physical examination of prospective salaried employees; and of all steamship crews before they leave the home port, each voyage.
- (e) Supervision of all matters concerning quarantine and immigration affecting the Company's interests.
- (f) In the Tropical Divisions, supervision and recommendation in all matters pertaining to sanitation.
- (g) Sanitation of the Company's steamships.

For the effective performance of these many and varied duties the Company maintains fully equipped hospitals and dispensaries in the Tropical Divisions, and dispensary service with sanitary staffs in the ports of New York, Boston, and New Orleans.

PERSONNEL OF THE MEDICAL DEPARTMENT

Name	Title	Graduate of
W. E. Deeks, M.D., A.M.	General Manager, New York	McGill University, Montreal, Quebec
R. C. Connor, M.D.	Assistant General Manager, New York	University of Texas, Galveston, Texas
H. C. Clark, M.D.	Director of Laboratories and Preventive Medicine, New York	University of Pennsylvania, Philadelphia, Pa.
F. G. Banting, M.D., LL.D., D.Sc.	Consultant in Metabolism of Tropical Diseases, Toronto	University of Toronto, Ontario
A. Castellani, M.D., C.M.G., F.R.C.P.	Consultant in Tropical Derma- tology, London	{ University of Florence, Italy University of Bonn, Germany
W. M. James, M.D.	Consultant in Tropical Medi- cine, Panama, R. P.	
		University of Virginia, Charlottesville, Va.

F. B. Mallory, M.D., A.B., A.M.	Consulting Pathologist, Boston, Mass.	Harvard University, Boston, Mass.
M. J. Rosenau, M.D., A.M.	Consultant in Preventive Medicine and Hygiene, Boston, Mass.	University of Pennsylvania, Philadelphia, Pa.
R. P. Strong, M.D.	Consultant in Laboratory and Medical Research Work, Boston, Mass.	Harvard University, Boston, Mass.
P. F. Murphy, M.D.	Port Medical Officer, New Orleans, La.	Tulane University, New Orleans, La.
J. M. Lawler, M.D.	Port Medical Officer, New York, N. Y.	Vanderbilt University, Nashville, Tenn.
J. A. Gatlin, M.D.	Sanitary Inspector, New York, N. Y.	Memphis Hospital Medical College, Memphis, Tenn.
F. X. Crawford, M.D.	Port Medical Officer, Boston, Mass.	Harvard University, Boston, Mass.
Harry Eno, M.D.	{District Medical Officers, Cristobal, C.Z.(Samaritan Hospital)}	Cornell University (Med. Col.), N. Y. City
S. J. Taylor, M.D.		
		University of Texas, Galveston, Texas

BANES DIVISION

Name	Title	Graduate of
J. R. Ariza, M.D.	Superintendent	Havana University, Havana, Cuba
A. F. Ruiz, M.D.	Assistant Superintendent	Havana University, Havana, Cuba
R. A. Hernandez, M.D.	Physician	Indiana University, Indianapolis, Ind.
V. Bustillo, M.D.	Physician	Loyola University, Chicago, Ill.
J. Medrano, M.D.	District Medical Officer	Havana University, Havana, Cuba
T. de la Torre, M.D.	District Medical Officer	University of Maryland, Baltimore, Md.
W. Menk, M.D.	Bacteriologist and Roentgenologist	Hamburg University, Hamburg, Germany
Catharin Cotter, R.N.	Matron	Kings County Hospital, Brooklyn, N. Y.
Ruth E. Pease, R.N.	Nurse	Springfield Hospital, Springfield, Mass.
Francisca Archer, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Violet R. Perkins, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Viola I. Clarke, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Mabel L. Heron, R.N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—54

COLOMBIA DIVISION

Name	Title	Graduate of
L. M. Drennan, M.D.	Superintendent	Georgetown University, Washington, D. C.
E. I. Salisbury, M.D.	Assistant Superintendent	Jefferson Medical College, Philadelphia, Pa.
J. A. Fontalvo, M.D.	District Medical Officer	Universidad de Bolivar, Cartagena, Col.
R. Sacnz, M.D.	Physician	Jefferson Medical College, Philadelphia, Pa.
A. Gonzalez, M.D.	Physician	Universidad Nacional de Bogota, Col.
J. E. Llinas, M.D.	Physician	Universidad Nacional de Bogota, Col.
J. C. Register	Laboratory Technician	Army Medical Laboratory, Washington, D. C.
Martha W. Vessels, R.N.	Matron	Capital City School of Nursing, Washington, D. C.
Mary C. Walsh, R.N.	Nurse	St. Joseph Hospital, St. Paul, Minn.
Julia M. Daley, R.N.	Nurse	Boston City Hospital, Boston, Mass.
Doris Melville, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Mabel Willis, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Edna Coombs, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Adelaide Fletcher, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Ruby Fray, R.N.	Nurse	Nuttall's Nursing Home, Cross Roads, Jamaica
Lee Cahusac, R.N.	Nurse	Nuttall's Nursing Home, Cross Roads, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—98

COSTA RICA DIVISION

Name	Title	Graduate of
A. A. Facio, M.D., F.A.C.S.	Superintendent	University of Pennsylvania, Philadelphia, Pa. (Medico-Chirurgical College)
M. D. Rojas, Ph.C., M.D.	Assistant Surgeon	Tulane University, New Orleans, La.
C. M. Jimenez, M.D.	Physician	University of Brussels, Belgium
A. Castro, G., M.D.	Physician	University of Maryland, Baltimore, Maryland
F. Zumbado, M.D., B.S.C., M.R.C.S., L.R.C.P.	District Medical Officer	Durham University, Durham, England
R. Marchena, M.D.	District Physician	George Washington University, Washington, D. C.
Louisa Kurath, R.N.	Matron	M. E. Hospital, Philadelphia, Pa.
Edna M. Dowler, R.N.	Nurse	Mercer & New Jersey State Hospital, Trenton, N.J.—Post Graduate Polyclinic
Agnes K. Donégan, R.N.	Nurse	Victoria Hospital, Yorkshire, England
Francisca M. Farrell, R.N.	Nurse	St. Vincents Hospital, New York, City
Sibyl E. Chaplin, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Josephine W. Shrine, R.N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY
TECHNICIANS—91

GUATEMALA DIVISION

Name	Title	Graduate of
N. P. Macphail, M.D.	Superintendent	Aberdeen University, Aberdeen, Scotland
E. B. Ross, M.D.	Surgeon	Vanderbilt University, Nashville, Tenn.
R. Aguilar, M.D., D.D.S.	Physician	Universidad Central, Tegucigalpa, Honduras, C. A., Strycher Dental School, New York, N.Y.
L. R. Fletcher, M.D.	Physician	University of Chicago, Chicago, Ill.
L. R. Matthews	Laboratory Technician	
Myra Ellerby, R.N.	Matron	Middlesex Hospital, London, England
Johanna M. Brosnan, R.N.	Assistant Matron	Hospital St. John & Elizabeth, London, England
Lilian Dixon, R.N.	Nurse	Hamilton General Hospital, Hamilton, Ontario, Canada
Katharine L. Hamilton,	Nurse	Eastern Maine Hospital, Bangor, Maine
Elizabeth H. Smith, R.N.	Nurse	The Memorial Hospital, Roxboro, Philadelphia, Pa.
Alice McGinn, R.N.	Nurse	St. Vincent Hospital, New York, N. Y.
Stella Norton, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Carmen Mendez, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY
TECHNICIANS—87

JAMAICA DIVISION

Name	Title	Graduate of
I. W. McLean, M.D.	Superintendent	University of Maryland, Baltimore, Md.
J. G. Moseley, M.D., B.S., M.R.C.S., L.R.C.P.	District Physician	University of London, England
C. A. Moseley, M.D.	District Physician	University College Hospital Medical School, London, England
F. R. Evans, M.D.	District Physician	Bellevue Hospital Medical College, New York, N. Y.
A. C. Lushington, L.R.C.S., L.F.P. and S.	District Physician	University of Edinburgh and Glasgow, Scotland

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY
TECHNICIANS—16

PANAMA DIVISION

Name	Title	Graduate of
O. T. Brosius, M.D., D.T.M. and H., F.A.C.P.	Superintendent	Tufts College Medical School, Boston, Mass. London School of Tropical Medicine, London, England
I. E. Peon, M.D.	Surgeon	Tulane University, New Orleans, La.
R. L. Carroll, M.D.	Physician	University of Pennsylvania, Philadelphia, Pa.
M. E. Smith	Laboratory Technician	
Mae A. Kenney, R.N.	Matron	Worcester City Hospital, Worcester, Mass.
Clara Totske, G.N.	Nurse	Hamburg, Eppendorf, Staats Krankenhaus Stalten, Hamburg, Germany
TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—45		

PRESTON DIVISION

Name	Title	Graduate of
J. de la Guardia, M.D.	Superintendent	Jefferson Medical College, Philadelphia, Pa.
P. S. Malaret, M.D.	District Medical Officer	Medico-Chirurgical College, Philadelphia, Pa.
O. Ortiz, M.D.	Physician	Havana University, Havana, Cuba
J. C. Castellanos, M.D.	Physician	Tulane University, New Orleans, La.
W. Cordes, M.D.	Bacteriologist and Roentgen- ologist	Marburg University, Germany
Margaret Shiplette, R.N.	Matron	Kings County Hospital, New York, N. Y.
Violet E. Reams, R.N.	Nurse	New York Post-Graduate Hospital, New York, N. Y.
Murrell DeBard, R.N.	Nurse	James M. Jackson Memorial Hospital, Miami, Florida
Ethel Roblin, R.N.	Nurse	Grant McDonald Hospital, Toronto, Canada
Margarita Hernandez, R.N.	Nurse	Santo Tomas Hospital Training School, Panama City, Panama
Catherine Clarke, R.N.	Nurse	Kingston General Hospital, Kingston, Jamaica
Helen Greenlees, R.N.	Nurse	Kingston General Hospital, Kingston, Jamaica
TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—57		

TELA RAILROAD COMPANY

Name	Title	Graduate of
R. B. Nutter, M.D.	Superintendent	Tufts Medical School, Boston, Mass.
E. J. Whitaker, M.D.	Physician	University of Iowa, Iowa City, Iowa
A. E. Moure, M.D.	Physician	Sorbonne Medical School, Paris, France
G. Izaguirre, M.D.	Physician	Syracuse Medical School, Syracuse, N. Y.
J. C. McDaniel	Bacteriologist	
Helen Flanagan, R.N.	Matron	Massachusetts General Hospital, Boston, Mass.
Hilda Hagelberg, R.N.	Nurse	Schassburg Hospital, Siebenburgen, Germany
Leonora Hippolyte, G.N.	Nurse	Kingston General Hospital, Kingston, Jamaica
Lilla Maud Peart, G.N.	Nurse	Kingston General Hospital, Kingston, Jamaica
TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—67		

TRUXILLO RAILROAD COMPANY

Name	Title	Graduate of
B. M. Phelps, M.D.	Superintendent	Vanderbilt University, Nashville, Tenn.
W. A. Hutchinson, M.D.	Assistant Surgeon	Tulane University, New Orleans, La.
W. Jantzen	Bacteriologist	Kiel University, Germany
Gena H. Robertson, R.N.	Matron	Sarah Leigh Hospital, Norfolk, Va.
Helen E. Keyser, R.N.	Assistant Matron	St. Vincent Charity Hospital, Cleveland, Ohio
Esther Gomez, G.N.	Nurse	St. Tomas Hospital Training School, Panama City, Panama
Altagracia Barsallo, G.N.	Nurse	St. Tomas Hospital Training School, Panama City, Panama
Maria Garcia, G.N.	Nurse	Max. Peralta Hospital, Cartago, Costa Rica
TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—80		

SUMMARY OF WORK DONE

	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	M.	F.	M.	F.	M.	F.	M.	F.
PERSONS DEPENDENT UPON THE MEDICAL DEPARTMENT FOR TREATMENT:								
Employees:								
From Temperate Zone	347	8	98	8	184	11	215	10
Others	4,357	77	7,902	268	6,026	214	4,160	142
Non-employees:								
From Temperate Zone	917	389	507	242	38	76	317	238
Others	9,571	11,666	9,091	7,698	2,759	4,264	6,937	5,560
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees	355	4,434	106	8,170	195	6,240	225	4,302
Non-employees	1,306	21,237	749	16,789	114	7,023	556	12,497
TOTAL	1,661	25,671	855	24,959	309	13,263	781	16,800
Passengers on steamships	-	-	-	-	-	-	-	-
Officers, crews and ships' laborers	-	-	-	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-
GRAND TOTAL	-	-	-	-	-	-	-	-
PATIENTS TREATED IN HOSPITALS:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone	72	1	79	5	94	4	174	6
Others	1,641	11	2,886	117	3,784	77	1,978	63
Non-employees:								
From Temperate Zone	12	7	42	6	58	18	120	46
Others	128	313	169	314	718	544	736	353
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees	73	1,652	84	3,003	98	3,861	180	2,041
Non-employees	19	441	48	483	76	1,262	166	1,088
GRAND TOTAL	92	2,093	132	3,486	174	5,123	346	3,130
TREATMENTS IN HOSPITAL DISPENSARIES:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone	1,423	4	127	11	713	7	816	40
Others	17,983	188	27,075	499	14,592	355	4,337	195
Non-employees:								
From Temperate Zone	281	368	63	37	161	119	197	232
Others	4,660	9,829	1,237	3,161	1,650	1,919	912	633
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees	1,427	18,171	138	27,574	720	14,947	856	4,533
Non-employees	649	14,489	100	4,398	280	3,569	429	1,546
GRAND TOTAL	2,076	32,660	238	31,972	1,000	18,516	1,285	6,079
TREATMENTS IN FIELD DISPENSARIES:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone	-	-	43	-	35	1	426	4
Others	-	-	24,127	496	3,853	50	9,498	138
Non-employees:								
From Temperate Zone	-	-	-	-	-	-	45	56
Others	-	-	57	135	5	36	749	212
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees	-	-	43	24,623	36	3,903	430	9,636
Non-employees	-	-	-	192	-	41	101	961
GRAND TOTAL	-	-	43	24,815	36	3,944	531	10,597

ND VITAL STATISTICS

Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-Total		Total
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
77	3	116	9	327	17	248	12	246	11	1,858	89	1,947
3,512	1,920	2,468	211	5,704	155	4,558	92	4,527	120	49,214	3,202	52,416
39	57	9	32	124	129	24	56	38	68	2,013	1,288	3,301
4,755	7,132	1,504	1,791	2,328	3,355	695	1,363	697	1,547	38,337	44,376	82,713
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
80	11,432	125	2,679	344	5,859	260	4,650	257	4,647	1,947	52,416	54,363
96	11,887	41	3,295	253	5,683	80	2,058	106	2,244	3,301	82,713	86,014
176	23,319	166	5,974	597	11,542	340	6,708	363	6,891	5,248	135,129	140,377
-	-	-	-	-	-	-	-	-	-	-	-	56,338
-	-	-	-	-	-	-	-	-	-	-	-	31,706
-	-	-	-	-	-	-	-	-	-	-	-	88,044
-	-	-	-	-	-	-	-	-	-	-	-	228,421
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
13	-	82	6	125	7	162	7	187	3	988	39	1,027
16	1	1,364	91	1,856	23	2,817	27	2,096	23	18,438	4 33	18,871
16	2	11	12	42	29	127	119	16	25	444	264	708
2	-	210	476	138	239	328	855	210	424	2,639	3,518	6,157
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
13	17	88	1,455	132	1,879	169	2,844	190	2,119	1,027	18,871	19,898
18	2	23	686	71	377	246	1,183	41	634	708	6,157	6,865
31	19	111	2,141	203	2,256	415	4,027	231	2,753	1,735	25,028	26,763
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
388	2	877	39	767	5	2,138	143	1,117	67	8,366	318	8,684
2,759	517	5,986	669	7,643	274	7,596	358	4,411	198	92,382	3,253	95,635
496	150	118	306	152	244	687	1,011	191	312	2,346	2,779	5,125
556	712	1,307	2,709	2,267	3,769	1,439	2,672	764	1,223	14,792	26,627	41,419
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
390	3,276	916	6,655	772	7,917	2,281	7,954	1,184	4,609	8,684	95,635	104,319
646	1,268	424	4,016	396	6,036	1,698	4,111	503	1,987	5,125	41,419	46,544
1,036	4,544	1,340	10,671	1,168	13,953	3,979	12,065	1,687	6,596	13,809	137,054	150,863
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
224	-	209	3	-	-	547	1	137	-	1,621	9	1,630
1,214	4,108	8,724	680	-	-	12,808	113	5,067	34	75,291	5,619	80,910
-	3	2	12	-	-	-	1	1	-	48	72	120
968	963	203	849	-	-	49	160	61	147	2,092	2,502	4,594
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
224	15,322	212	9,404	-	-	548	12,921	137	5,101	1,630	80,910	82,540
3	1,931	14	1,052	-	-	1	209	1	208	120	4,594	4,714
227	17,253	226	10,456	-	-	549	13,130	138	5,309	1,750	85,504	87,254

SUMMARY OF WORK DONE

	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	M.	F.	M.	F.	M.	F.	M.	F.
TOTAL NUMBER OF TREATMENTS IN HOSPITAL AND FIELD DISPENSARIES:								
Employees:								
From Temperate Zone	1,423	4	170	11	748	8	1,242	44
Others	17,983	188	51,202	995	18,445	405	13,835	333
Non-employees:								
From Temperate Zone	281	368	63	37	161	119	242	288
Others	4,660	9,829	1,294	3,296	1,655	1,955	1,661	845
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees	1,427	18,171	181	52,197	756	18,850	1,286	14,168
Non-employees	649	14,489	100	4,590	280	3,610	530	2,506
GRAND TOTAL	2,076	32,660	281	56,787	1,036	22,460	1,816	16,674
NUMBER OF HOSPITAL DAYS:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone	810	7	1,531	28	1,778	71	1,525	57
Others	17,234	156	37,975	1,387	48,880	877	23,609*	643
Non-employees:								
From Temperate Zone	478	44	721	66	1,659	253	1,895	926
Others	1,841	2,935	2,234	3,496	10,898	5,199	9,276	3,471
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees	817	17,390	1,559	39,362	1,849	49,757	1,582	24,252
Non-employees	522	4,776	787	5,730	1,912	16,097	2,821	12,747
GRAND TOTAL	1,339	22,166	2,346	45,092	3,761	65,854	4,403	36,999
NUMBER OF TREATMENTS ABOARD PASSENGER STEAMSHIPS	-	-	-	-	-	-	-	-
NUMBER OF TREATMENTS BY PORT MEDICAL OFFICERS	-	-	-	-	-	-	-	-
NUMBER OF SEAMEN AND APPLICANTS EXAMINED BY PORT MEDICAL OFFICERS	-	-	-	-	-	-	-	-
DEATHS, HOSPITALS:								
Employees:								
From Temperate Zone	3	-	-	-	1	-	-	-
Others	66	-	76	-	83	-	57	-
Non-employees:								
From Temperate Zone	2	-	1	-	1	-	2	-
Others	25	-	25	-	34	-	36	-
Total:								
Employees	69	-	76	-	84	-	57	-
Non-employees	27	-	26	-	35	-	38	-
GRAND TOTAL	96	-	102	-	119	-	95	-
DEATHS, HOSPITAL DISPENSARIES:								
Employees:								
From Temperate Zone	0	-	-	-	-	-	-	-
Others	4	-	1	-	-	-	-	-
Non-employees:								
From Temperate Zone	0	-	-	-	-	-	-	-
Others	5	-	-	-	-	-	-	-
Total:								
Employees	4	-	1	-	-	-	-	-
Non-employees	5	-	-	-	-	-	-	-
GRAND TOTAL	9	-	1	-	-	-	-	-

* Including 1,342 days in Bobos Sick Camp.

SUMMARY OF WORK DONE

	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	M.	F.	M.	F.	M.	F.	M.	F.
DEATHS, FIELD DISPENSARIES:								
Employees:								
From Temperate Zone	—		—		—		—	
Others	—		1		1		3	
Non-employees:								
From Temperate Zone	—		—		—		—	
Others	—		—		1		—	
Total:								
Employees	—		1		1		3	
Non-employees	—		—		1		—	
GRAND TOTAL	—		1		2		3	
DEATHS, HOSPITALS AND ALL DISPENSARIES COMBINED:								
Employees:								
From Temperate Zone	3		—		1		—	
Others	70		78		84		60	
Non-employees:								
From Temperate Zone	2		1		1		2	
Others	30		25		35		36	
Total:								
Employees	73		78		85		60	
Non-employees	32		26		36		38	
GRAND TOTAL	105		104		121		98	
DEATHS, STEAMSHIP SERVICE:								
Passengers	—		—		—		—	
Officers, crews and ships' laborers	—		—		—		—	
TOTAL	—		—		—		—	
GRAND TOTAL—DEATHS AMONG PATIENTS TREATED: (Steamship service included)								
	—		—		—		—	
AVERAGE DAILY NUMBER OF PATIENTS IN HOSPITALS:								
Employees:								
From Temperate Zone	2.24		4.28		5.08		4.35	
Others	47.77		103.14		136.70		66.63	
Non-employees:								
From Temperate Zone	1.43		2.16		5.25		7.75	
Others	13.12		15.74		44.22		35.02	
Total:								
Employees	50.01		112.42		141.77		70.97	
Non-employees	14.55		17.90		49.48		42.77	
GRAND TOTAL	64.57		130.32		191.25		113.74	
AVERAGE DAILY NUMBER OF TREATMENTS IN HOSPITAL DISPENSARIES AND FIELD DISPENSARIES:								
Employees:								
From Temperate Zone	3.92		.50		2.08		3.53	
Others	49.92		143.40		51.78		38.92	
Non-employees:								
From Temperate Zone	1.78		.27		.77		1.46	
Others	39.80		12.61		9.92		6.88	
Total:								
Employees	53.84		143.90		53.86		42.45	
Non-employees	41.59		12.88		10.69		8.34	
GRAND TOTAL	95.43		156.78		64.55		50.79	

D VITAL STATISTICS—Continued

Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi Total		Total
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	19
-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	6
14	-	-	-	-	-	-	-	-	-	-	-	19
5	-	-	-	-	-	-	-	-	-	-	-	6
19	-	-	-	-	-	-	-	-	-	-	-	25
-	-	1	-	5	-	-	-	1	-	-	-	11
20	-	52	-	53	-	50	-	56	-	-	-	523
3	-	-	-	1	-	6	-	-	-	-	-	16
6	-	30	-	51	-	44	-	40	-	-	-	297
20	-	53	-	58	-	50	-	57	-	-	-	534
9	-	30	-	52	-	50	-	40	-	-	-	313
29	-	83	-	110	-	100	-	97	-	-	-	847
-	-	-	-	-	-	-	-	-	-	-	-	4
-	-	-	-	-	-	-	-	-	-	-	-	5
-	-	-	-	-	-	-	-	-	-	-	-	9
-	-	-	-	-	-	-	-	-	-	-	-	856
.49	-	2.04	-	4.05	-	3.70	-	5.92	-	-	-	32.16
.52	-	60.53	-	49.65	-	105.01	-	73.24	-	-	-	648.19
.73	-	.53	-	3.24	-	6.90	-	1.25	-	-	-	29.26
.06	-	21.83	-	11.71	-	30.87	-	18.00	-	-	-	190.57
1.01	-	62.57	-	53.70	-	108.71	-	79.17	-	-	-	680.35
.79	-	22.37	-	14.95	-	37.77	-	19.25	-	-	-	219.84
1.80	-	84.94	-	68.65	-	146.49	-	98.42	-	-	-	900.19
1.69	-	3.10	-	2.12	-	7.77	-	3.63	-	-	-	28.34
51.09	-	44.12	-	21.75	-	57.35	-	26.67	-	-	-	485.01
1.78	-	1.20	-	1.09	-	4.67	-	1.38	-	-	-	14.40
8.79	-	13.92	-	16.58	-	11.87	-	6.03	-	-	-	126.40
52.78	-	47.22	-	23.87	-	65.12	-	30.30	-	-	-	513.35
10.57	-	15.12	-	17.67	-	16.54	-	7.41	-	-	-	140.81
63.35	-	62.34	-	41.54	-	81.66	-	37.71	-	-	-	654.16

SUMMARY OF WORK DONE

	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	M.	F.	M.	F.	M.	F.	M.	F.
DEATH RATE PER THOUSAND PERSONS DEPENDENT ON THE COMPANY FOR TREATMENT (Steamship employees and passengers not included):								
Employees:								
From Temperate Zone		8.45		0.00		5.13		0.00
Others		15.79		9.55		13.46		13.94
Non-employees:								
From Temperate Zone		1.53		1.34		8.77		3.60
Others		1.41		1.49		4.98		2.88
Total:								
Employees		15.45		9.42		13.21		13.25
Non-employees		1.42		1.48		5.04		2.91
GRAND TOTAL		3.84		4.03		8.92		5.57
REPATRIATIONS:								
Employees:								
From Temperate Zone	-		2		1		1	
Others	-		57		4		1	
Non-employees:								
From Temperate Zone	-		-		-		-	
Others	-		-		-		-	
Total:								
Employees	-		59		5		2	
Non-employees	-		-		-		-	
GRAND TOTAL	-		59		5		2	
AVERAGE NUMBER OF HOSPITAL DAYS ANNUALLY, PER EM- PLOYEE:								
From Temperate Zone		2.30		14.71		9.48		7.03
Others		3.92		4.82		7.97		5.63
TOTAL		3.80		4.94		8.02		5.70
HOSPITAL ADMISSION RATE ANNUALLY, PER THOUSAND EM- PLOYEES:								
From Temperate Zone		206		792		503		800
Others		373		368		619		474
TOTAL		360		373		615		490
AVERAGE NUMBER DISPENSARY TREATMENTS ANNUALLY, PER EMPLOYEE:								
From Temperate Zone		4.02		1.71		3.88		5.72
Others		4.10		6.39		3.02		3.29
TOTAL		4.09		6.33		3.05		3.41
AVERAGE NUMBER OF EMPLOYEES NON-EFFECTIVE, PER THOUSAND EMPLOYEES:								
From Temperate Zone		6.31		40.38		26.05		19.33
Others		10.77		13.24		21.91		15.48
TOTAL		10.44		13.58		22.03		15.67
AVERAGE NUMBER OF EMPLOYEES PARTIALLY NON-EFFECTIVE, PER THOUSAND EMPLOYEES:								
From Temperate Zone		11.04		4.72		10.67		15.69
Others		11.26		17.55		8.30		9.04
TOTAL		11.24		17.39		8.37		9.37

AND VITAL STATISTICS—*Concluded*

Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-Total		Total
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
0.00		8.00		14.53		0.00		3.89				5.65
1.75		19.41		9.05		10.75		12.05				9.98
31.25		0.00		3.95		75.00		0.00				4.85
.50		9.10		8.97		21.37		17.82				3.59
1.74		18.90		9.35		10.18		11.62				9.82
.75		8.99		8.76		23.39		17.02				3.64
1.23		13.52		9.06		14.19		13.37				6.03
-		-		-		-		-				4
-		12		-		12		6				92
-		-		-		-		-				-
-		-		1		1		1				3
-		12		-		12		6				96
-		-		1		1		1				3
-		12		1		13		7				99
2.21		5.94		4.29		5.18		8.39				6.01
.02		8.22		3.08		8.22		5.74				4.50
.03		8.12		3.15		8.06		5.88				4.56
163		704		384		650		739				527
1		543		321		612		456				360
3		550		324		614		471				366
7.68		9.02		2.24		10.88		5.14				5.30
1.62		5.99		1.35		4.49		2.09				3.37
1.67		6.13		1.40		4.83		2.25				3.44
6.13		16.32		11.77		14.23		23.04				16.52
0.05		22.59		8.47		22.58		15.76				12.37
0.09		22.31		8.66		22.14		16.14				12.51
21.13		24.80		6.16		29.88		14.12				14.56
4.47		16.47		3.71		12.33		5.74				9.25
4.58		16.84		3.85		13.26		6.18				9.44

RECORD OF

				Banes Division		Colombia Division		Costa Rica Division	
				T.	O.	T.	O.	T.	O.
Remaining from last year	{	Emp.	{ M.	1	25	4	107	5	10
			{ F.	-	-	1	4	-	-
	{	Non-	{ M.	1	6	1	4	4	1
		emp.	{ F.	-	3	-	6	2	1
Admitted this year	{	Emp.	{ M.	71	1,616	75	2,779	89	3,68
			{ F.	1	11	4	113	4	7
	{	Non-	{ M.	11	122	41	165	54	70
		emp.	{ F.	7	310	6	308	16	58
Discharged	{	Emp.	{ M.	66	1,627	78	2,791	90	3,68
			{ F.	1	11	5	112	4	7
	{	Non-	{ M.	12	125	41	166	54	68
		emp.	{ F.	7	308	6	304	17	52
Remaining	{	Emp.	{ M.	6	14	1	95	4	9
			{ F.	-	-	-	5	-	-
	{	Non-	{ M.	-	3	1	3	4	5
		emp.	{ F.	-	5	-	10	1	2
Died	{	Emp.		3	66	-	76	1	8
		Non-emp.		2	25	1	25	1	3
Repatriated	{	Emp.		-	-	2	55	1	-
		Non-emp.		-	-	-	-	-	-
Total number of hospital days	{	Emp.	{ M.	810	17,234	1,531	37,975	1,778	48,88
			{ F.	7	156	28	1,387	71	87
	{	Non-	{ M.	478	1,841	721	2,234	1,659	10,89
		emp.	{ F.	44	2,935	66	3,496	253	5,19
Operations with general anaesthesia	{	Emp.		4	41	9	356	11	10
		Non-emp.		4	105	9	170	11	7
Operations with or without local anaesthesia	{	Emp.		16	455	24	2,558	124	4,85
		Non-emp.		9	76	8	257	458	1,91

HOSPITALS

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Total		Grand Total
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
1	60	—	1	—	61	2	25	3	81	3	57	19	518	537
—	1	—	—	—	3	—	—	—	1	—	2	1	12	13
6	11	1	—	—	4	1	5	8	2	—	10	22	57	79
1	9	—	—	—	14	—	2	4	17	—	9	7	72	79
173	1,918	13	15	82	1,303	123	1,831	159	2,736	184	2,039	969	17,920	18,889
6	62	—	1	6	88	7	23	7	26	3	21	38	421	459
114	725	15	2	11	206	41	133	119	326	16	200	422	2,582	3,004
45	344	2	—	12	462	29	237	115	838	25	415	257	3,446	3,703
171	1,923	12	16	82	1,334	121	1,835	160	2,726	183	2,030	963	17,970	18,933
6	62	—	1	5	91	7	22	6	26	3	22	37	422	459
118	721	15	2	11	207	42	134	124	315	16	205	433	2,563	2,996
41	343	1	—	12	469	29	235	112	842	22	418	247	3,440	3,687
3	55	1	—	—	30	4	21	2	91	4	66	25	468	493
—	1	—	—	1	—	—	1	1	1	—	1	2	11	13
2	15	1	—	—	3	—	4	3	13	0	5	11	76	87
5	10	1	—	—	7	—	4	7	13	3	6	17	78	95
—	57	—	1	1	52	5	45	—	50	1	56	11	486	497
2	36	1	—	—	29	1	21	6	44	—	40	14	254	268
1	1	—	—	—	12	—	—	—	12	—	6	4	90	94
—	—	—	—	—	—	—	1	—	1	—	1	—	3	3
525	22,267	177	172	708	20,780	1,489	17,837	1,282	37,949	2,141	26,429	11,391	229,523	240,914
57	643	—	19	35	1,253	37	235	65	275	15	232	315	5,077	5,392
895	9,276	243	21	95	2,415	829	1,757	1,250	3,829	235	2,216	7,405	34,487	41,892
926	3,471	24	—	99	5,532	351	2,504	1,263	7,408	221	4,337	3,247	34,882	38,129
16	140	—	2	3	89	13	135	4	85	5	99	65	1,051	1,116
44	95	1	—	2	112	17	124	22	72	12	51	122	808	930
34	1,341	1	2	10	1,060	49	1,014	65	933	42	691	365	12,909	13,274
19	291	—	1	4	231	28	182	67	509	10	174	603	3,633	4,236

RECORD OF

		Banes Division		Colombia Division		Costa Rica Division	
		T.	O.	T.	O.	T.	O.
Number of treatments administered	Emp. { M.	1,423	17,983	127	27,075	713	14,592
	{ F.	4	188	11	499	7	355
	Non- { M.	281	4,660	63	1,237	161	1,650
	emp. { F.	368	9,829	37	3,161	119	1,919
Patients sent to hospitals	Emp. { M.	71	1,616	68	1,593	73	2,476
	{ F.	1	11	4	63	4	43
	Non- { M.	11	122	41	161	54	666
	emp. { F.	7	310	6	295	10	484
Visits to lodgings	Emp. { M.	103	340	18	76	21	249
	{ F.	2	3	-	-	2	6
	Non- { M.	69	277	47	1	9	31
	emp. { F.	95	492	108	8	25	97
Operations with general anaesthesia	Emp.	-	-	-	-	-	2
	Non-emp.	-	-	-	5	-	-
Operations with or without local anaesthesia	Emp.	367	3,088	5	1,464	147	2,719
	Non-emp.	437	9,282	15	470	42	139
Died	Emp.	-	4	-	1	-	-
	Non-emp.	-	5	-	-	-	-
Repatriated	Emp.	-	-	-	2	-	-
	Non-emp.	-	-	-	-	-	-

*NOTE. — The Tela Railroad Company and the Truxillo Railroad Company do not report deaths occurring among employees.

HOSPITAL DISPENSARIES

Guatemala Division		Jamaica Division		Panama Division		Preston Division		*Tela Railroad		*Truxillo Railroad		*Total		*Grand Total
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
816	4,337	338	2,759	877	5,986	767	7,643	2,138	7,596	1,117	4,411	8,366	92,382	100,748
40	195	2	517	39	669	5	274	143	358	67	198	318	3,253	3,571
197	912	496	556	118	1,307	152	2,267	687	1,439	191	764	2,346	14,792	17,138
232	633	150	712	306	2,709	244	3,769	1,011	2,672	312	1,223	2,779	26,627	29,406
173	1,918	14	15	82	1,303	123	1,831	158	1,473	184	2,039	946	14,264	15,210
6	62	-	1	6	88	7	23	7	25	3	21	33	337	375
114	725	14	2	11	181	41	133	119	318	16	200	421	2,508	2,929
45	344	2	-	12	435	29	237	115	746	25	415	251	3,266	3,517
4	3	53	99	-	-	77	192	71	174	3	-	350	1,133	1,483
-	-	-	35	-	-	-	1	12	34	-	-	16	79	95
2	9	110	30	3	-	12	82	106	78	19	3	377	511	888
14	35	44	45	2	1	30	142	160	161	16	4	494	985	1,479
-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
-	-	-	-	-	1	1	-	-	-	-	1	1	7	8
29	407	10	103	16	1,054	55	1,259	88	350	48	398	765	10,842	11,607
1	106	51	658	8	499	27	409	94	207	37	169	712	11,939	12,651
-	-	-	5	-	-	-	8	-	-	-	-	-	18	18
-	-	2	1	-	1	-	30	-	-	-	-	2	37	39
-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

and non-employees treated at the Hospital Dispensaries or in their lodgings.

RECORD OF

		†Banes Division		Colombia Division		Costa Rica Division	
		T.	O.	T.	O.	T.	O.
Number of treatments administered	{ Emp. { M.	—	—	43	24,127	35	3,853
		—	—	—	496	1	50
	{ Non-emp. { M.	—	—	—	57	—	5
		{ F.	—	—	—	135	—	36
Number of surgical treatments		—		9,291		1,142	
Number of medical treatments		—		15,567		2,838	
Total number of treatments		—		24,858		3,980	
Patients sent to hospitals	{ Emp. { M.	—	—	7	1,186	16	1,192
		0	—	—	50	—	31
	{ Non-emp. { M.	—	—	—	4	—	36
		{ F.	—	—	—	13	6	48
Visits to lodgings	{ M.	—		964		81	
	{ F.	—		87		8	
Died	{ Emp. { M.	—	—	—	1	—	1
		—	—	—	—	—	—
	{ Non-emp. { M.	—	—	—	—	—	—
		{ F.	—	—	—	—	—

†NOTE. — The Banes Division and the Preston Division did not operate any Field Dispensaries during the year 1927.

*NOTE. — The Tela Railroad Company and the Truxillo Railroad Company do not report deaths occurring among employees

FIELD DISPENSARIES

Guatemala Division		Jamaica Division		Panama Division		†Preston Division		*Tela Railroad		*Truxillo Railroad		*Total		*Grand Total
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
426	9,498	224	11,214	209	8,724	-	-	547	12,808	137	5,067	1,621	75,291	76,912
4	138	-	4,108	3	680	-	-	1	113	-	34	9	5,619	5,628
45	749	-	968	2	203	-	-	-	49	1	61	48	2,092	2,140
56	212	3	963	12	849	-	-	1	160	-	147	72	2,502	2,574
2,980		5,570		2,793		-		3,553		925		26,254		
8,148		11,910		7,889		-		10,126		4,522		61,000		
11,128		17,480		10,682		-		13,679		5,447		87,254		
2	391	1	83	-	2,159	-	-	1	1,263	2	263	29	6,537	6,566
-	5	-	22	-	215	-	-	-	2	-	2	-	327	327
1	2	-	8	-	98	-	-	-	8	-	12	1	168	169
-	19	-	3	1	558	-	-	-	92	-	10	7	743	750
352		598		235		-		60		1,185		3,475		
149		366		123		-		6		106		845		
-	3	-	8	-	-	-	-	*	*	*	*	-	13	13
-	-	-	6	-	-	-	-	*	*	*	*	-	6	6
-	-	-	5	-	-	-	-	*	*	*	*	-	5	5
-	-	-	-	-	-	-	-	*	*	*	*	-	1	1

and non-employees treated at the Field Dispensaries or in their lodgings.

DEATHS BY AGE

Age and Sex	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Under 1 year { M.	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-
{ F.	-	-	-	3	-	-	-	2	-	-	-	-	-	-	-	-
1 to 5 years { M.	-	-	-	3	-	-	-	-	-	-	-	1	-	-	-	-
{ F.	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-
6 to 10 years { M.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
{ F.	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
11 to 20 years { M.	-	8	-	2	-	5	-	2	-	4	-	2	-	6	-	-
{ F.	-	-	-	3	-	-	-	2	-	-	-	1	-	-	-	-
21 to 30 years { M.	-	25	-	3	-	26	-	2	-	10	-	1	-	21	-	-
{ F.	-	-	-	4	-	-	-	6	-	-	-	2	-	-	-	-
31 to 40 years { M.	1	23	-	2	-	22	-	1	-	24	-	3	-	16	1	-
{ F.	-	-	-	5	-	1	-	3	-	-	1	8	-	-	-	-
41 to 50 years { M.	-	7	-	-	-	15	-	1	-	23	-	3	-	12	1	-
{ F.	-	-	-	-	-	1	-	1	-	-	-	4	-	-	-	-
51 to 60 years { M.	-	2	-	-	-	4	-	-	-	15	-	3	-	2	-	-
{ F.	-	-	-	-	-	-	-	3	-	1	-	1	-	-	-	-
61 to 70 years { M.	2	3	-	-	-	3	-	1	1	6	-	2	-	-	-	-
{ F.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Over 70 years { M.	-	2	2	-	-	-	1	1	-	1	-	-	-	1	-	-
{ F.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown . . { M.	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-
{ F.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL . . { M.	3	70	2	12	-	76	1	8	1	83	-	17	-	60	2	2
{ F.	-	-	-	18	-	2	-	17	-	1	1	18	-	-	-	1
GRAND TOTAL	3	70	2	30	-	78	1	25	1	84	1	35	-	60	2	3

*NOTE. — The mortality records of the Tela Railroad Company and the Truxillo Railroad Company are defective, inasmuch as deaths among employees and non-employees are not reported unless they actually occur in the Hospitals; whereas the mortality statistics of the other Medical Departments include *all* deaths among employees, and the deaths of non-employees residing on the plantations when the deceased have been given medical attention by members of our medical or dispensary staffs.

NATIVITY AND SEX

Jamaica Division				Panama Division				Preston Division				*Tela Railroad				*Truxillo Railroad				*Semi-Total				*Total
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
-	-	-	3	-	-	-	3	-	-	-	10	-	-	-	3	-	-	-	7	-	-	-	29	29
-	-	-	-	-	-	-	2	-	-	1	10	-	-	1	7	-	-	-	6	-	-	2	30	32
-	-	-	2	-	-	-	1	-	-	-	2	-	-	-	-	-	-	2	-	-	-	11	11	
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	3	-	-	-	1	-	-	-	11	11
-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	2	-	-	-	1	-	-	-	8	8
-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	2	-	-	-	-	-	-	6	6	
-	1	-	-	-	-	-	4	-	9	-	1	-	10	-	3	1	4	-	2	1	47	-	17	65
-	1	-	1	-	-	-	1	-	-	-	2	-	-	-	3	-	-	-	5	-	1	-	20	21
-	1	-	-	-	8	-	1	1	22	-	2	-	25	-	1	-	23	-	3	1	161	-	19	181
-	1	-	-	-	-	-	4	-	1	-	6	-	-	-	7	-	1	-	4	-	3	-	39	42
-	5	-	-	-	14	-	1	1	11	-	2	-	13	3	6	-	15	-	3	2	143	4	23	172
-	1	-	-	-	-	-	7	-	-	-	2	-	-	-	4	-	-	-	3	-	2	1	32	35
-	4	-	-	1	11	-	-	-	5	-	2	-	-	-	1	-	6	-	-	1	83	1	11	96
-	1	-	-	-	-	-	-	-	-	-	2	-	-	1	1	-	-	-	2	-	2	1	11	14
-	1	2	-	-	13	-	1	2	2	-	1	-	2	-	-	-	3	-	-	2	44	2	6	54
-	-	-	-	-	1	-	1	-	-	-	1	-	-	1	-	-	-	-	-	-	2	1	6	9
-	2	-	-	-	4	-	1	-	1	-	-	-	-	-	1	-	1	-	1	3	20	-	9	32
-	2	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	3	5
-	-	1	-	-	1	-	1	1	2	-	1	-	-	-	-	-	1	-	-	1	8	4	3	16
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	5	-	1	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
-	14	3	5	1	51	-	13	5	52	-	24	-	50	3	17	1	55	-	19	11	511	11	137	670
-	6	-	1	-	1	-	17	-	1	1	27	-	-	3	27	-	1	-	21	-	12	5	160	177
-	20	3	6	1	52	-	30	5	53	1	51	-	50	6	44	1	56	-	40	11	523	16	297	847

DEATHS BY NATIVITY

NATIVITY:	Banes Div.	Colom- bia Div.	Costa Rica Div.	Guate- mala Div.	Ja- maica Div.	Pan- ama Div.	Pres- ton Div.	*Tela Rail- road	*Trux- illo R.R.	*Total
Barbados	1	—	3	—	—	1	—	—	—	5
British Honduras	—	—	1	—	—	—	—	4	1	6
British West Indies (other than Jamaica and Barbados)	—	2	3	—	—	4	—	1	—	10
Canada	—	—	—	—	1	—	—	—	—	1
China	1	—	1	—	—	—	2	1	—	5
Colombia	—	98	1	—	—	2	—	—	—	101
Costa Rica	—	—	31	—	—	4	—	—	1	36
Cuba	50	—	—	—	—	—	47	—	1	98
Dutch West Indies	—	1	—	—	—	—	—	—	—	1
England	—	—	—	—	—	—	—	—	—	—
French West Indies	—	—	—	1	—	—	—	—	—	1
Germany	—	—	—	—	—	—	—	2	1	3
Guatemala	—	—	1	66	—	—	—	1	—	68
Hayti	35	—	—	—	—	2	32	—	—	69
Honduras	—	—	—	11	—	1	—	72	73	157
India	—	—	—	1	5	1	—	—	—	7
Italy	—	1	—	—	—	—	—	—	—	1
Jamaica	13	2	67	2	21	44	22	5	4	180
Mexico	—	—	—	—	—	—	—	—	1	1
Nicaragua	—	—	9	—	—	2	—	—	5	16
Norway	—	—	—	—	1	—	—	1	—	2
Palestine	—	—	—	—	—	—	—	1	—	1
Panama	—	—	2	2	—	21	—	—	—	25
Porto Rico	—	—	—	—	—	—	1	—	—	1
Salvador	—	—	—	9	—	—	—	9	8	26
Spain	4	—	—	—	—	—	4	1	—	9
Syria	—	—	1	—	—	—	—	—	—	1
United States	1	—	1	2	1	1	2	1	—	9
Unknown	—	—	—	4	—	—	—	1	2	7
TOTAL	105	104	121	98	29	83	110	100	97	847

* NOTE. — The mortality records of the Tela Railroad Company and the Truxillo Railroad Company are defective, inasmuch as deaths among employees and non-employees are not reported unless they actually occur while the patient is confined in the Hospitals; whereas the mortality statistics of the other Medical Departments include *all* deaths among employees, and the deaths of non-employees residing on the plantations when the deceased have been given medical attention by members of our medical or dispensary staffs.

CLASSIFICATION OF

	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.
	T.	O.	T.	O.	T.	O.	T.	O.
ENDEMIC OR INFECTIOUS DISEASES:								
Typhoid fever (abdominal typhoid and para-typhoid):								
Typhoid fever	-	3	-	2	-	2	-	1
Paratyphoid fevers	-	-	-	-	-	1	-	-
Malarial fever or cachexia:								
Estivo autumnal	-	8	-	5	-	2	-	1
Tertian	-	-	-	-	-	1	-	-
Quartan	-	1	-	-	-	-	-	-
Mixed	-	-	-	1	-	-	-	-
Clinical	-	-	-	-	-	-	-	5
Cachexia	-	-	-	-	-	4	-	-
Hemoglobinuric fever	-	7	-	2	-	11	-	-
Diphtheria	-	-	-	-	-	-	-	-
Influenza	-	-	-	-	-	1	-	1
Dysentery:								
Amebic	-	-	-	4	-	-	-	-
Bacillary	-	1	-	-	-	-	-	1
Unspecified or due to other causes	-	-	-	1	-	-	-	-
Erysipelas	-	-	-	-	-	1	-	-
Epidemic cerebro-spinal meningitis	-	3	-	-	-	-	-	-
Purulent or septicemic infection	-	-	-	5	-	1	-	6
Tetanus	-	-	-	-	-	-	2	-
Tuberculosis of the respiratory system:								
Acute pulmonary tuberculosis	-	12	-	3	-	5	-	3
Other forms of tuberculosis of respiratory organs	-	-	-	-	-	-	-	2
Tuberculosis of the intestines or peritoneum	-	-	-	1	-	-	-	-
Tuberculosis of the vertebral system	-	-	-	-	-	-	-	-
Disseminated tuberculosis:								
Acute (including miliary tuberculosis of the lungs, except that specified as chronic or pulmonary)	-	-	-	1	-	-	-	1
Chronic	-	-	-	-	-	-	-	-
Syphilis (includes syphilitic infection of any organ, tissue or structure of the body):								
Tertiary	-	-	-	-	-	4	-	-
Hereditary	-	-	-	-	-	-	-	-
Period not specified	-	-	-	-	-	-	-	-
GENERAL DISEASES NOT INCLUDED ABOVE:								
Cancer or other malignant tumors of the buccal cavity:								
Cancer of the jaw	-	-	-	-	-	1	-	-
Cancer or other malignant tumors of the stomach and liver:								
Cancer of the esophagus	-	-	-	1	-	-	-	-
Cancer of the stomach	-	-	-	-	-	1	-	-
Cancer of the liver and gall bladder	-	-	-	-	-	-	2	-
Cancer or other malignant tumors of the peritoneum, intestines and rectum:								
Cancer of the intestines (except rectum)	-	-	-	-	-	1	-	-
Cancer of the rectum and anus	-	-	-	-	-	-	1	-
Others	-	-	-	-	-	-	1	-
Cancer or other malignant tumors of the female genital organs:								
Cancer of the ovary and fallopian tubes	-	-	-	-	-	1	-	-
Cancer of the uterus	-	-	-	-	-	-	1	-
Others	-	-	-	-	-	-	-	-
Cancer or other malignant tumors of the breast	-	-	-	-	-	-	1	-
Cancer or other malignant tumors of other or unspecified organs:								
Cancer of the lung and pleura	-	-	-	-	-	-	-	-
Cancer of the pancreas	-	-	-	-	-	-	-	-
Cancer of the bones (except jaw)	-	-	-	-	-	1	-	-
Others	-	-	-	-	-	1	-	-

Jamaica Division			Panama Division			Preston Division			Tela Railroad			Truxillo Railroad			Semi-total				Total	Deaths in Hospitals			
Non-mp. Emp.			Non-mp. Emp.			Non-mp. Emp.			Non-mp. Emp.			Non-mp. Emp.			Emp.		Non-Emp.			Emp.		Non-Emp.	
O.	T.	O.	T.	O.	T.	T.	O.	T.	T.	O.	T.	T.	O.	T.	T.	O.	T.	O.		T.	O.	T.	O.
-	-	-	-	-	-	1	2	-	-	3	-	-	-	-	1	10	-	4	15	1	10	-	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	2	-	-
-	-	-	-	1	-	-	4	1	-	1	-	-	1	-	-	24	1	20	45	-	22	1	17
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	3	5	-	2	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	1	-	1
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	1	-	1
2	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	7	-	5	12	-	5	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	-	4	-	-
1	-	-	-	-	-	1	3	-	-	-	-	-	6	1	1	33	1	4	39	1	31	1	4
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4	-	1	-	3	1	-	8	6	-	3	4	-	2	-	-	44	-	19	63	-	37	-	12
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-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	2	2	-	-	-	2
-	-	-	-	-	1</																		

CLASSIFICATION OF DEATHS

GENERAL DISEASES NOT INCLUDED ABOVE— Continued	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
Chronic rheumatism or gout:								
Chronic rheumatism	—	—	—	—	1	—	—	—
Beri-beri	—	—	—	—	—	—	1	—
Diabetes	—	—	—	—	—	1	—	—
Anemia, Chlorosis:								
Pernicious anemia	—	1	—	1	—	—	—	—
Other anemias and chlorosis	—	—	—	—	—	—	—	—
Diseases of the thyroid gland:								
Exophthalmic goitre	—	—	—	1	—	—	—	—
Other general diseases:								
Purpura hemorrhagica	—	—	—	—	—	—	—	—
Others	—	—	—	—	—	—	—	—
DISEASES OF THE NERVOUS SYSTEM AND ORGANS OF SPECIAL SENSE:								
Encephalitis	—	—	—	1	—	—	—	—
Meningitis:								
Simple	—	—	1	5	—	—	—	3
Non-epidemic cerebro-spinal meningitis	—	—	—	—	—	—	—	—
Progressive locomotor ataxia (tabes dorsalis)	—	—	—	1	—	2	—	—
Other diseases of the spinal cord:								
Paralysis agitans (Parkinson's disease)	—	—	—	—	—	—	—	—
Cerebral hemorrhage, apoplexy:								
Cerebral hemorrhage	—	—	1	1	—	1	—	1
Cerebral thrombosis and embolism	—	—	—	—	—	—	—	—
Paralysis (without specified cause):								
Hemiplegia	—	—	—	—	—	1	—	—
Other forms of paralysis	—	—	—	—	—	—	1	—
General paralysis (of the insane)	—	—	—	—	—	—	1	—
Epilepsy	—	1	—	—	—	—	—	—
Infantile convulsions (under 5 years of age)	—	—	—	—	—	—	—	—
DISEASES OF THE CIRCULATORY SYSTEM:								
Pericarditis	—	—	—	—	—	1	—	—
Acute endocarditis and myocarditis:								
Acute endocarditis	—	—	—	1	—	—	—	—
Acute myocarditis	—	1	—	—	—	—	—	—
Angina pectoris	—	—	—	1	—	—	—	—
Other diseases of the heart:								
Chronic endocarditis	—	1	—	—	—	2	—	—
Chronic myocarditis	—	2	—	2	1	3	1	1
Other chronic diseases of the heart	—	1	—	—	—	3	1	1
Aneurism	—	—	—	1	—	—	—	—
Atheroma and other diseases of the arteries	—	—	—	2	—	1	—	—
Embolism and thrombosis (except cerebral)	—	—	—	—	—	—	—	—
Hemorrhage without determined cause; other dis- eases of the circulatory system	—	—	—	—	—	—	—	—
DISEASES OF THE RESPIRATORY SYSTEM:								
Diseases of the larynx (except tuberculosis and cancer)								
Bronchitis:								
Acute	—	—	—	—	—	—	—	—
Chronic	—	—	—	1	—	—	—	—
Broncho-pneumonia (including capillary bronchitis):								
Broncho-pneumonia	—	4	—	12	—	10	1	3
Pneumonia:								
Lobar	1	13	—	10	—	1	—	15
Not otherwise specified	—	—	—	—	—	1	—	—
Pleurisy:								
Empyema of thoracic cavity	—	—	—	—	—	1	—	—
Gangrene of the lung	—	—	—	—	—	—	—	1
Asthma	—	—	—	—	—	—	—	—
Other diseases of the respiratory system (tuberculosis excepted):								
Others	—	—	—	1	—	—	—	—

[illegible]

CLASSIFICATION OF DEATHS

	Banes Division		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
DISEASES OF THE DIGESTIVE SYSTEM:								
Diseases of the pharynx and tonsils (including adenoids):								
Ludwig's angina	-	1	-	-	1	-	-	-
Others	-	-	-	-	-	-	-	-
Ulcer of the stomach and duodenum:								
Ulcer of the stomach	-	-	1	1	-	-	1	-
Ulcer of the duodenum	-	-	-	-	-	-	1	-
Other diseases of the stomach (cancer excepted):								
Gastritis	-	-	-	-	-	-	-	-
Stricture or stenosis of pylorus	-	1	-	-	-	-	-	-
Diarrhea and enteritis (under 2 years of age)	-	-	5	-	-	-	-	-
Diarrhea and enteritis (2 years and over)	-	-	-	1	-	-	1	-
Appendicitis and typhlitis	-	-	1	-	2	-	-	-
Hernia, intestinal obstruction:								
Hernia	-	-	-	-	-	1	1	-
Intestinal obstruction	-	2	1	-	-	-	1	-
Acute yellow atrophy of the liver	-	-	-	1	1	-	-	-
Cirrhosis of the liver:								
Returned as alcoholic	-	-	-	-	-	-	1	-
Not returned as alcoholic	-	-	-	-	1	1	-	-
Other diseases of the liver:								
Abscess of the liver, amebic	-	-	-	-	-	-	-	-
Other diseases of the liver	-	-	-	-	-	-	-	-
Diseases of the pancreas except cancer	-	-	-	1	-	-	-	-
Peritonitis of unstated cause	-	-	-	1	-	-	1	-
Other diseases of the digestive system (cancer and tuberculosis excepted)	-	-	-	-	-	-	-	-
NON-VENEREAL DISEASES OF THE GENITO-URINARY SYSTEM AND ITS ADNEXA:								
Acute nephritis (including unspecified under ten years of age)	-	-	-	3	1	-	-	-
Chronic nephritis (including unspecified over ten years of age)	1	2	-	2	1	12	2	4
Other diseases of the kidneys and their adnexa (diseases of the kidney in pregnancy not included)	-	-	-	-	-	1	2	-
Diseases of urethra, urinary abscess, etc.:								
Stricture of the urethra	-	-	-	-	-	-	-	-
Others	-	-	-	-	-	2	1	-
Cysts and other benign tumors of the ovary	-	-	-	-	-	-	1	-
Salpingitis or pelvic abscess	-	-	-	-	1	-	-	-
THE PUERPERAL STATE:								
Accidents of pregnancy:								
Abortion	-	-	-	-	-	-	-	-
Other accidents of pregnancy	-	-	-	-	1	-	-	-
Puerperal hemorrhage	-	-	-	-	1	-	-	-
Puerperal septicemia	-	-	1	-	1	-	1	-
Puerperal albuminuria or convulsions	-	-	-	-	2	-	-	-
DISEASES OF THE SKIN OR CELLULAR TISSUE:								
Gangrene	-	-	-	1	-	-	-	-
Boil, carbuncle, furuncle	-	-	-	-	-	-	-	-
Phlegmon, acute abscess	-	-	-	-	1	-	-	-
DISEASES OF THE BONES AND ORGANS OF LOCOMOTION:								
Diseases of the bones (tuberculosis excepted)	-	-	-	-	-	-	-	-
MALFORMATIONS:								
Congenital malformations (still-births excepted):								
Hydrocephalus	-	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-	-

BY DISEASE—Continued

Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-total				Total	Deaths in Hospitals			
Non-emp. Emp.		Non-emp. Emp.		Non-emp. Emp.		Non-emp. Emp.		Non-emp. Emp.		Emp.		Non-emp.			Emp.	Non-emp.		
T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.			T. O.	T. O.	
-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	2	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1
-	1	-	-	1	-	-	1	-	-	1	2	2	1	6	1	2	2	1
-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	18	18	-	-	-	8
-	-	-	1	-	-	-	-	-	-	-	4	-	-	4	-	4	-	-
-	-	-	-	1	-	-	1	-	-	-	2	-	5	7	-	2	-	5
-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	1	-	1
-	-	-	-	-	-	-	-	-	-	-	3	-	3	6	-	3	-	3
-	-	-	1	-	-	-	-	-	-	-	2	-	1	3	-	2	-	1
-	-	-	-	-	-	-	-	1	-	-	-	-	3	3	-	-	-	3
-	-	-	-	-	-	-	-	-	1	-	1	-	2	3	-	1	-	2
-	-	-	1	-	-	-	-	1	-	-	1	1	-	2	-	1	1	-
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4	-	-	-	2	-	4	-	1	-	1	32	-	9	42	1	27	-	8
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-	-	-	-	-	-	-	-	-	-	-	-	-						

Jamaica Division	Panama Division	Preston Division	Tela Railroad	Truxillo Railroad	Semi-total	Total	Deaths in Hospitals				
Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
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- - -	- - -	- - 1	- - -	- - -	- - - 2	2	- - - 1				
- - -	- - -	- - -	- - -	- - 1	- - - 2	2	- - - 2				
- - -	- - 2	- - 1	- - 1	- - 4	- - - 8	8	- - - 7				
- - -	- - -	- - -	- - 1	- - -	- - - 2	2	- - - 2				
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- - -	- - -	- - -	- - -	- 1 - 1	- 1 - 2	3	- 1 - 2				
- - -	- - -	- - -	- - -	- - -	- 2 - 1	3	- 1 - 1				
- - -	- - -	- - -	- - -	- - -	- - -	-	- - -				
- - -	- - -	- - -	- - -	- - -	- 5 - 5	10	- 5 - 5				
- 20 3 6	1 52 - 30	5 53 1 51	- 50 6 44	1 56 - 40	11 523 16 297	847	11 486 14 254				

DEPATRIATIONS

[illegible]

RECORD OF REPA

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
DISEASES OF THE SKIN OR CELLULAR TISSUE:																
Phlegmon, acute abscess	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Other diseases of the skin and its adnexa:																
Ulcer of the skin	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Other diseases of the skin and adnexa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DISEASES OF THE BONES AND ORGANS OF LOCOMOTION:																
Diseases of the joints (tuberculosis and rheumatism ex-																
cepted)	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Other diseases of the bones or organs of locomotion . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OLD AGE:																
Old age (senility)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
EXTERNAL CAUSES:																
Traumatism by other crushing (vehicles, railways, land-																
slides, etc.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	-	-	-	-	2	57	-	-	1	4	-	-	1	1	-	-

RIATIONS—Concluded

Jamaica Division			Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Total				Total
Emp.		Non-Emp.	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	4		
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	1		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	-	-	-	3		
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-		
-	-	-	-	12	-	-	-	-	1	-	12	-	1	-	-	6	-	1	4	92	-	3	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

REATED IN HOSPITALS

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospitals			
Emp.	Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Total	Emp.		Non-Emp.	
	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.		T.	O.	T.	O.
-	-	1	2	8	1	1	1	14	-	3	-	-	-	-	3	56	5	28	92	1	10	-	4
1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	11	-	5	16	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
159	2	63	16	554	4	22	21	673	20	154	34	499	4	70	125	3,478	51	848	4,502	-	22	1	17
68	1	39	6	37	2	5	7	131	7	41	19	57	1	25	56	1,093	26	324	1,499	-	2	-	3
4	-	1	-	13	-	-	-	4	-	3	1	17	-	-	1	81	-	12	94	-	1	-	1
3	-	4	-	5	-	-	2	23	2	5	6	29	-	6	9	83	3	25	120	-	1	-	1
42	2	15	1	19	-	-	-	102	-	13	10	181	-	36	58	1,146	23	336	1,563	-	5	-	2
14	-	3	-	-	-	-	-	12	-	3	-	25	-	2	1	64	-	15	80	-	4	-	-
3	-	1	1	10	-	5	-	5	-	1	-	21	-	2	4	101	1	34	140	1	31	1	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	8	-	2	11	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	3	-	-	-	1	-	-	-	6	6	-	-	-	1
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
-	-	-	4	17	-	1	5	41	2	1	-	1	1	-	27	373	8	11	419	-	-	-	-
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8	-	-	-	-	-	-	11	139	4	5	3	-	-	-	34	244	6	22	306	-	1	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	11	-	-	-	-
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-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
4	-	2	1	20	2	2	1	58	6	23	1	31	2	8	14	321	19	70	424	-	4	-	1
-	-	-	2	-	-	2	-	2	-	-	-	-	1	-	5	11	3	4	23	-	3	-	1
4	-	2	-	1	-	2	-	19	-	1	4	13	2	1	7	65	5	14	91	-	4	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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8	-	-	-	-	1	-	-	1	-	2	1	2	-	2	4	41	2	19	66	-	1	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	7	-	-	7	1	3	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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1	-	1	-	2	-	-	-	1	-	-	-	3	-	-	-	13	-	1	14	-	-	-	-
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-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	-	4	-	-	-	-
3	-	-	-	70	-	-	-	-	-	-	-	-	-	-	1	80	-	-	81	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-
7	1	1	1	3	-	-	-	1	-	4	-	4	-	1	1	32	1	11	45	-	23	-	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	1	-	2	-	1	-	-	-	2	-	2	-	11	13	-	2	-	7
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-

CLASSIFICATION OF DISEASES

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division				Jamaica Division			
	Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Endemic or Infectious Diseases —Continued																				
Tuberculosis of the respiratory system:																				
Acute pulmonary tuberculosis	2	25	—	3	4	37	1	3	1	17	—	12	1	18	1	15	—	—	—	—
Other forms of tuberculosis of respira- tory organs	—	—	—	—	—	—	—	—	—	3	—	—	—	1	—	—	—	—	—	—
Tuberculosis of the meninges or of the central nervous system																				
Tuberculosis of the intestines or peri- toneum	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Tuberculosis of the vertebral column . .	—	—	—	—	—	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—
Tuberculosis of the joints	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	—	—	—	—	—
Tuberculosis of other organs and struc- tures:																				
Tuberculosis of the skin and sub- cutaneous cellular tissue	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Tuberculosis of the bones (except vertebral column)	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tuberculosis of the lymphatic system (except the mesenteric and retro- peritoneal glands)	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Tuberculosis of the genito-urinary system	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tuberculosis of other organs	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Disseminated tuberculosis:																				
Acute (including miliary tuberculosis of the lungs, except that specified as chronic or pulmonary)	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Chronic	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Syphilis (includes syphilitic infection of any organ, tissue or structure of the body):																				
Primary	—	2	—	—	—	4	3	2	—	27	1	2	—	14	—	—	—	—	—	—
Secondary	—	38	—	—	—	5	—	1	1	73	1	20	—	27	—	6	—	—	—	—
Tertiary	—	16	—	1	1	59	—	5	1	53	2	15	2	24	—	6	—	—	—	—
Hereditary	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	1	—	—	—	—
Period not specified	—	—	—	—	—	96	—	1	—	2	—	—	1	6	—	—	—	—	—	—
Soft chancre	—	1	—	—	—	29	—	1	—	31	—	6	2	15	2	3	—	—	—	1
Gonococcal infection except that of the eye	1	18	—	3	—	101	3	4	5	178	12	26	2	57	2	17	1	—	—	—
Gonococcal ophthalmia	—	—	—	—	—	2	1	1	—	1	—	—	—	—	—	—	—	—	—	—
General Diseases Not Included Above:																				
Cancer or other malignant tumors of the buccal cavity:																				
Cancer of the lip	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cancer of the tongue	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cancer of the mouth	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cancer of the jaw	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Others	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cancer or other malignant tumors of the stomach and liver:																				
Cancer of the pharynx	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cancer of the esophagus	—	—	—	—	—	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—
Cancer of the stomach	—	—	—	—	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—	—
Cancer of the liver and gall bladder .	—	—	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—	—
Cancer or other malignant tumors of the peritoneum, intestines and rectum:																				
Cancer of the mesentery and peri- toneum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cancer of the intestines (except rectum)	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Cancer of the rectum and anus	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—

DEATHS IN HOSPITALS—Continued

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospitals			
Non-Emp.			Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.	Non-Emp.		
O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.			T.	O.	
10	-	4	2	19	-	5	1	38	-	13	-	24	-	3	11	188	2	58	259	-	37	-	12
-	-	-	-	-	-	-	-	5	1	1	-	5	-	-	-	14	1	1	16	-	1	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	1	-	-
-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	4	5	-	-	-	1
-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	4	-	1	5	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	-	1	4	-	-	-	-
2	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	3	-	2	5	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	2	-	-	-	-
2	-	1	-	1	-	1	-	1	-	-	-	2	-	1	1	8	-	3	12	1	8	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	1
-	-	1	-	4	-	-	1	1	-	-	-	3	-	-	1	55	4	5	65	-	-	-	-
5	-	2	-	9	-	1	-	24	1	5	-	3	-	3	1	184	2	38	225	-	-	-	-
108	-	33	-	44	-	10	3	43	3	49	1	22	1	4	9	369	6	123	507	-	7	-	2
-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	4	-	4	8	-	-	-	2
14	-	15	-	-	-	-	-	1	-	-	-	-	-	-	1	119	-	16	136	-	-	-	1
12	-	-	3	8	1	-	1	28	-	4	-	12	-	1	6	136	4	15	161	-	-	-	-
37	-	13	1	23	1	5	3	37	6	15	3	38	-	3	16	489	24	86	615	-	-	-	-
-	-	-	-	1	-	-	-	2	1	2	-	-	-	-	-	6	2	3	11	-	-	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	1	2	1	-	-	-
-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	3	-	2	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	4	-	4	8	-	4	-	1
1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	4	5	-	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	-	-	-	1
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	3	-	-	-	1

DIED IN HOSPITALS—Continued

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospitals			
Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.		Non-Emp.			
	T.	O.		T.	O.		T.	O.		T.	O.		T.	O.		T.	O.			T.	O.	T.	O.
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	
-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	3	3	-	-	-	1	
-	-	2	-	-	1	-	-	2	2	-	-	-	-	-	-	2	11	13	-	-	-	1	
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	
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EATED IN HOSPITALS—Continued

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospitals			
Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Emp.	Non-Emp.		Total		Emp.	Non-Emp.		
	T.	O.		T.	O.		T.	O.		T.	O.		T.	O.		T.	O.				T.	O.	T.
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3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	2	7	-	1	-	-
-	-	-	-	-	-	-	1	-	1	-	1	-	1	-	-	10	-	3	13	-	10	-	2
-	-	-	-	10	-	-	1	-	1	-	3	-	-	-	-	17	-	1	18	-	7	-	-
-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6	-	2	8	-	3	-	-
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1	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	8	-	6	14	-	2	-	-
2	-	-	-	1	-	-	1	-	2	-	2	-	1	-	1	11	1	7	20	-	1	-	1
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3	-	1	1	-	-	2	-	5	-	6	-	-	-	-	1	12	1	13	27	-	-	-	-
-	-	1	-	-	-	-	1	6	-	1	-	1	-	1	2	13	-	4	19	-	1	-	-
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6	-	3	1	2	-	1	2	21	1	6	-	1	-	4	4	64	1	18	87	-	-	-	-
4	-	-	1	6	1	-	1	5	-	6	-	1	-	-	6	35	2	6	49	-	-	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	-	-
9	1	3	-	11	1	4	1	1	2	11	-	2	-	2	6	38	6	24	74	-	-	-	-
-	-	-	2	11	-	1	-	85	-	1	-	29	-	2	2	133	-	5	140	-	-	-	-
12	-	-	2	28	-	1	-	1	-	1	-	-	-	-	3	110	1	17	131	-	-	-	-
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14	-	3	-	4	-	-	1	16	3	5	-	77	-	5	5	159	5	17	186	-	-	-	-
10	-	-	-	3	-	1	2	22	3	10	-	23	-	1	10	95	7	21	133	-	-	-	-
-	-	-	-	-	-	1	-	1	-	-	-	9	-	-	-	11	-	1	12	-	-	-	-
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-	-	-	-	1	-	-	1	1	-	2	-	-	-	3	1	5	-	5	11	-	2	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-

CLASSIFICATION OF DISEASES

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division				Jamaica Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Diseases of the Circulatory System:																				
—Continued																				
Other diseases of the heart:																				
Chronic endocarditis	—	1	—	—	—	1	—	—	—	5	—	—	—	—	—	—	—	—	—	—
Chronic myocarditis	1	3	—	1	—	4	1	2	1	7	—	3	1	1	1	1	—	—	—	—
Other chronic diseases of the heart	—	5	—	—	—	12	—	1	—	14	—	13	1	4	1	6	—	—	—	—
Aneurism	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Atheroma and other diseases of the arteries	—	2	—	2	—	4	—	—	—	2	1	5	—	—	—	1	—	—	—	—
Embolism and thrombosis (except cerebral).	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Diseases of the veins (varices, hemorrhoids, phlebitis, etc.)	—	3	—	—	1	25	2	2	—	8	—	2	4	4	—	1	—	2	—	—
Diseases of the lymphatic system (lymphangitis, etc.)	1	2	—	—	3	66	—	2	1	73	3	9	2	30	1	13	1	—	—	—
Hemorrhage without determined cause; other diseases of the circulatory system	—	—	—	—	—	1	—	—	—	—	—	—	—	3	—	—	—	—	—	—
Diseases of the Respiratory System:																				
Diseases of the nasal fossae and their adnexa:																				
Diseases of the nasal fossae	—	—	—	—	—	6	—	—	—	—	1	—	—	9	1	6	—	—	—	—
Others	—	—	—	—	—	2	—	—	—	6	—	3	—	—	—	—	—	—	—	—
Diseases of the larynx (except tuberculosis and cancer)	—	—	—	1	—	3	—	—	1	2	—	1	—	4	1	3	—	—	—	—
Bronchitis:																				
Acute	6	49	—	12	1	130	—	—	—	3	—	2	7	47	3	16	—	—	—	—
Chronic	1	—	—	—	—	16	—	—	—	1	—	2	—	—	—	1	—	—	—	—
Not otherwise defined under 5 years of age	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—
Not otherwise defined 5 years and over	—	—	—	—	—	—	—	—	1	21	—	2	—	—	—	—	—	—	—	—
Broncho-pneumonia (including capillary bronchitis):																				
Broncho-pneumonia	—	17	—	10	—	29	—	9	—	14	1	9	—	7	—	3	—	—	—	—
Capillary bronchitis	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Pneumonia:																				
Lobar	1	24	—	—	1	49	2	2	—	4	—	—	—	46	—	16	—	—	—	—
Not otherwise specified	—	—	—	—	—	—	—	—	—	7	—	3	—	1	—	—	—	—	—	—
Pleurisy:																				
Pleurisy	—	3	2	1	—	10	—	1	—	7	1	—	—	—	1	—	—	—	—	2
Empyema of thoracic cavity	—	—	—	—	1	1	—	1	—	1	—	—	—	1	—	1	—	—	—	—
Congestion or parenchymatous hemorrhage of the lung																				
Gangrene of the lung	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Asthma	—	11	—	1	1	18	—	—	—	17	—	11	—	1	—	3	—	—	—	—
Emphysema of the lung	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other diseases of the respiratory system (tuberculosis excepted):																				
Chronic interstitial pneumonia (including occupational diseases of the lungs)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Diseases of the mediastinum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Diseases of the Digestive System:																				
Diseases of the mouth and adnexa:																				
Diseases of the teeth and gums	1	24	—	—	2	8	—	1	1	21	2	—	1	8	—	3	—	—	—	—
Other diseases of the buccal cavity and adnexa	—	1	—	1	—	6	—	1	—	5	—	1	—	—	—	—	—	—	—	—

EATED IN HOSPITALS—Continued

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospitals			
Emp.	Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.	Non-Emp.		
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.			T.	O.	
1	-	-	-	-	-	-	1	-	-	2	-	-	1	-	1	8	1	2	12	-	3	-	-
5	-	2	-	-	-	1	-	4	2	3	-	5	-	-	3	29	4	13	49	-	12	2	3
20	-	6	2	5	-	5	1	4	-	1	-	3	-	-	5	67	1	32	105	1	10	-	4
3	-	-	-	1	-	-	-	1	-	3	-	2	-	-	-	8	-	3	11	-	2	-	-
-	-	-	1	1	-	-	1	2	2	3	-	-	1	1	2	11	4	12	29	-	3	-	-
-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	3	-	-	3	-	1	-	-
11	-	2	-	-	-	2	6	10	3	1	1	-	-	-	12	63	5	10	90	-	-	-	-
26	-	5	2	18	1	4	3	28	2	6	1	15	-	1	15	258	7	40	320	-	-	-	-
-	-	-	-	2	-	1	1	-	-	1	-	-	-	-	1	6	-	2	9	-	-	-	-
2	-	1	-	3	-	-	-	2	-	1	1	1	-	2	1	23	1	11	36	-	-	-	-
1	-	2	-	-	-	1	-	3	-	-	-	1	-	2	1	13	-	8	22	-	-	-	-
-	-	1	-	-	-	2	1	-	-	1	-	3	-	1	2	12	1	10	25	-	-	-	1
45	-	8	6	46	1	9	5	53	3	22	5	38	-	14	30	411	7	83	531	-	-	-	-
5	-	1	-	4	1	-	-	4	1	-	-	6	-	1	1	36	2	5	44	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	5	5	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	6	-	3	1	27	-	6	34	-	-	-	-
5	-	-	1	3	-	2	-	6	-	5	-	4	-	2	1	85	1	40	127	-	29	1	7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
11	-	4	-	50	-	1	-	48	1	14	-	47	-	8	2	279	3	45	329	1	89	-	18
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	8	-	4	12	-	1	-	-
11	-	1	-	14	-	-	1	36	1	7	4	11	-	3	5	92	7	13	117	-	-	-	-
1	-	-	-	1	-	1	-	3	-	-	-	1	-	-	1	9	1	3	14	-	5	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	2	-	2	-	-
4	1	1	3	8	-	5	-	5	-	2	-	6	-	8	5	70	1	31	107	-	-	-	-
1	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	2	1	1	4	-	-	-	-
-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
-	-	-	-	5	-	1	-	-	-	1	-	1	-	-	-	10	-	2	12	-	1	-	-
16	-	2	-	20	-	3	1	17	-	2	-	35	1	4	8	149	3	15	175	-	-	-	-
1	-	-	-	9	-	2	-	-	-	1	-	3	-	4	-	25	-	10	35	-	-	-	-

CLASSIFICATION OF DISEASES

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division				Jamaica Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Non-Venereal Diseases of the Genito-Urinary System and Its Adnexa:																				
—Continued																				
Other diseases of the kidneys and their adnexa (diseases of the kidney in pregnancy not included)	-	-	-	1	4	7	-	11	-	3	-	5	-	-	-	-	-	-	-	1
Calculi of the urinary passages	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of the bladder (except tumors)	1	-	-	4	-	5	-	4	1	15	-	5	-	1	-	1	1	-	-	-
Diseases of the urethra, urinary abscess, etc.:																				
Stricture of the urethra	-	6	-	1	-	13	-	1	-	6	-	8	-	5	1	1	-	-	-	-
Others	-	-	-	-	-	3	-	2	1	5	-	1	-	-	1	-	-	-	-	-
Diseases of the prostate (except tumors)	-	4	1	1	1	1	-	1	-	1	-	1	-	2	-	1	-	-	-	-
Non-venereal diseases of the male genital organs	-	14	-	1	-	21	-	1	-	20	2	4	1	9	1	2	-	-	1	-
Cysts and other benign tumors of the ovary	-	1	-	9	-	-	-	2	-	-	-	4	-	-	1	-	-	-	-	-
Salpingitis or pelvic abscess	-	-	1	10	-	8	-	30	-	1	-	7	-	1	-	2	-	-	-	-
Benign tumors of the uterus	-	1	-	2	-	1	-	7	-	1	-	2	-	-	-	1	-	-	-	-
Non-puerperal uterine hemorrhage	-	1	-	1	-	2	-	1	-	-	-	1	-	-	-	1	-	-	-	-
Metritis	-	-	-	3	-	-	-	-	-	2	-	3	-	-	-	-	-	1	-	-
Other diseases of the female genital organs	-	-	-	2	-	8	-	19	-	3	1	12	-	1	6	16	-	-	-	-
Non-puerperal diseases of the breast (cancer excepted)	-	-	-	1	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-
The Puerperal State:																				
Accidents of pregnancy:																				
Abortion	-	-	-	15	-	-	-	17	-	1	-	14	-	-	-	5	-	-	-	-
Ectopic gestation	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Other accidents of pregnancy	-	-	1	10	-	3	-	10	-	-	-	12	-	1	-	2	-	-	-	-
Puerperal hemorrhage	-	-	-	2	-	-	-	1	-	-	-	2	-	-	-	1	-	-	-	-
Other accidents of childbirth:																				
Cesarian section	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other surgical operations and instrumental delivery	-	-	-	6	-	-	-	2	-	-	-	1	-	-	1	-	-	-	-	-
Others	-	-	2	31	-	-	-	4	-	-	-	1	-	-	-	-	-	-	-	-
Phlegmasia alba dolens, puerperal embolism, etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Puerperal septicemia	-	-	-	2	-	-	-	4	-	-	-	6	-	-	-	-	-	-	-	-
Puerperal albuminuria or convulsions	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Childbirth (without other explanation)	-	-	2	35	-	1	1	32	-	-	6	42	-	-	4	14	-	-	-	-
Puerperal diseases of the breast	-	-	-	-	-	-	-	1	-	-	-	3	-	-	-	1	-	-	-	-
Diseases of the Skin or Cellular Tissue:																				
Gangrene	-	1	-	1	-	3	-	-	-	1	-	2	-	2	-	-	-	-	-	-
Boil, carbuncle, furuncle	-	4	-	4	1	33	-	2	1	39	-	7	-	27	3	6	-	1	1	-
Phlegmon, acute abscess	1	57	-	10	1	137	-	11	-	49	-	20	2	58	1	25	-	-	1	-
Tinea and alopecia	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Pruritis	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Other diseases of the skin and its adnexa:																				
Trichophytosis	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Scabies	-	7	-	-	-	-	-	-	-	8	-	-	-	6	-	-	-	-	-	-
Chiggers (pulex penetrans)	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red bug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pemphigus contagiosus	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Mycetoma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground itch	-	1	-	1	-	-	-	-	-	1	-	-	-	9	-	3	-	-	-	-
Filaria medinensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elephantiasis	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Myositis of skin	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-

EATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospitals			
Emp.			Non-Emp.	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
O.	T.	O.		T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
2	2	6	-	6	1	9	-	3	1	5	-	2	1	2	1	23	6	39	69	-	2	-	2	
-	-	-	-	1	-	-	-	-	-	3	-	-	-	1	1	1	-	5	7	-	-	-	-	
8	-	4	1	2	-	6	1	1	-	2	-	3	-	5	5	35	-	31	71	-	-	-	-	
9	-	-	-	19	-	3	-	7	1	1	-	2	-	1	-	67	2	16	85	-	1	-	-	
10	-	-	-	4	1	-	-	-	-	-	-	2	-	-	1	24	2	3	30	-	2	-	1	
2	-	1	-	-	-	-	-	-	-	-	-	1	-	-	1	11	1	5	18	-	-	-	-	
12	-	4	1	26	-	1	4	4	4	6	-	3	-	2	8	109	8	21	146	-	-	-	-	
-	-	2	-	2	-	1	-	-	-	2	-	1	-	1	-	4	1	21	26	-	-	-	-	
2	-	5	-	-	-	7	-	-	2	18	-	-	-	10	-	12	3	89	104	-	-	-	1	
1	-	-	-	-	-	4	-	-	-	11	-	1	-	3	-	5	-	30	35	-	-	-	1	
-	-	-	-	-	-	-	-	-	-	1	1	-	-	3	1	3	-	8	12	-	-	-	-	
-	-	-	-	-	-	1	-	1	6	19	-	-	-	1	-	4	6	27	37	-	-	-	-	
9	-	32	-	3	3	12	2	1	7	31	-	-	2	8	2	25	19	132	178	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	4	5	-	-	-	-	
2	-	14	-	-	-	7	-	-	3	9	-	1	-	6	-	4	3	87	94	-	-	-	1	
1	-	3	-	1	-	2	-	-	-	3	-	-	-	1	-	2	-	10	12	-	-	-	-	
-	-	2	-	-	-	2	-	1	1	11	-	-	1	2	-	5	3	51	59	-	-	-	2	
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	7	-	-	-	2	
-	-	-	-	-	-	1	-	-	-	3	-	-	-	-	-	-	-	4	4	-	-	-	-	
-	-	2	-	-	-	3	-	-	2	7	-	-	-	-	-	-	3	21	24	-	-	-	-	
-	-	1	-	-	1	-	-	-	2	4	-	-	-	2	-	-	5	43	48	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	
-	-	2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	17	17	-	-	-	5	
-	-	1	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	7	7	-	-	-	5	
-	3	48	-	-	6	7	-	-	20	98	-	-	6	43	-	1	48	319	368	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	8	8	-	-	-	-	
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	4	11	-	1	-	-	
6	-	2	2	9	1	4	1	20	2	1	4	27	1	2	11	166	8	28	213	-	-	-	1	
55	-	16	6	43	2	14	7	93	5	28	7	111	1	16	24	603	10	140	777	-	1	-	1	
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	2	4	-	-	-	-	
-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	5	-	-	5	-	-	-	-	
-	-	-	-	-	-	-	-	2	-	-	-	5	-	1	-	8	-	1	9	-	-	-	-	
-	-	-	-	8	-	2	1	4	-	1	1	1	-	-	2	34	-	3	39	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	2	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	1	-	2	4	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	1	9	-	1	2	4	-	1	3	24	-	6	33	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	5	-	-	5	-	-	-	-	
3	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	6	-	-	7	-	-	-	-	

CLASSIFICATION OF DISEASES

	Banes Division		Non- Emp.		Colombia Division		Non- Emp.		Costa Rica Division		Non- Emp.		Guatemala Division		Non- Emp.		Jamaica Division	
	Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Diseases of the Skin or Cellular Tissue:																		
—Continued																		
Dhobie itch	—	—	—	—	1	8	—	—	—	1	—	—	—	—	—	—	—	—
Prickly heat	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Ulcer of the skin	—	38	—	—	3	76	—	1	2	93	—	32	1	43	1	19	—	2
Ainhum	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Ulcerating granuloma of the pudenda	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Impetigo contagiosa	—	2	—	—	—	8	2	—	—	1	—	1	—	2	—	4	—	—
Urticaria	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—
Other diseases of the skin and adnexa	1	8	1	1	—	36	—	1	9	85	1	36	4	53	1	16	—	—
Diseases of the Bones and Organs of Locomotion:																		
Diseases of the bones (tuberculosis excepted)	1	3	—	2	—	5	—	2	—	—	—	1	—	1	1	2	—	—
Diseases of the joints (tuberculosis and rheumatism excepted)	—	2	—	—	—	11	—	—	—	5	—	4	—	5	—	1	—	—
Other diseases of the bones or organs of locomotion	—	3	—	—	—	27	—	1	—	2	—	2	1	—	2	1	—	—
Malformations:																		
Congenital malformations (still-births excepted):																		
Hydrocephalus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Malformations of heart	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others	—	—	—	—	—	—	1	—	—	2	—	5	—	—	—	—	—	—
Diseases of Early Infancy:																		
Congenital debility, icterus and sclerema:																		
Marasmus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Inanition	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	1	—	—
Icterus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sclerema	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Premature birth, or consequence of labor:																		
Premature birth	—	—	—	—	—	—	2	—	—	—	—	2	—	—	—	—	—	—
Injury at birth	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—
Other diseases peculiar to early infancy:																		
Asphyxia neonatorum	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Atalectasis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Umbilical infection	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Umbilical hemorrhage	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lack of care	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Old Age:																		
Old age (senility)	1	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
External Causes:																		
Suicide	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Poisoning by food	—	—	—	—	2	1	—	1	—	—	—	—	1	—	—	—	—	—
Poisoning by venomous animals	—	—	—	—	—	1	—	1	—	11	—	5	—	8	—	—	—	—
Other acute poisonings	—	—	—	—	—	—	—	—	—	—	—	3	—	—	1	—	—	—
Burns and scalds	—	4	—	4	—	8	—	3	—	14	—	10	1	1	—	2	—	—
Mechanical suffocation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Absorption of irrespirable or poisonous gas	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Accidental drowning	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
Injury by firearms	—	1	1	2	—	7	—	2	—	7	—	6	—	9	1	5	—	—
Injury by cutting or piercing instruments	8	255	—	7	1	76	—	7	—	200	1	48	2	132	1	20	—	—
Injury by falls	1	10	—	4	1	14	—	3	2	25	2	7	6	28	—	13	—	—

TREATED IN HOSPITALS—Continued

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospital			
Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.			
O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.			O.	T.	O.	
-	-	1	-	-	-	-	-	-	-	-	3	-	-	1	12	-	1	14	-	-	-	-	
-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	1	1	3	-	-	-	-	
45	1	9	1	110	-	3	1	71	2	11	3	126	1	6	12	604	5	81	702	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	-	1	4	-	-	-	-
1	1	2	-	-	1	-	-	1	-	1	-	3	-	-	-	18	4	8	30	-	-	-	-
-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	4	-	2	6	-	-	-	-
53	1	16	3	10	-	4	4	60	4	8	3	44	-	4	27	349	8	86	470	-	-	-	-
7	-	2	-	5	-	4	-	3	2	1	-	3	-	-	1	27	3	14	45	-	1	-	-
27	-	6	1	5	1	3	1	12	2	6	-	17	-	1	5	84	3	21	113	-	-	-	-
1	-	-	-	-	-	-	4	88	1	3	-	2	-	-	5	123	3	7	138	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	9	11	-	-	-	1
-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	2	-	-	-	2
-	-	2	-	-	-	-	-	-	-	1	-	-	-	5	-	-	-	12	12	-	-	-	7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	2	-	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	4	4	-	-	-	1
-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	1	3	4	-	-	-	1
-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	1	4	-	1	6	1	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	3	4	-	1	-	3
-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	3	3	-	2	8	-	-	-	-
-	-	-	-	1	-	-	-	7	1	-	-	1	-	-	-	29	1	6	36	-	1	-	-
2	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	3	1	5	9	-	1	-	-
4	1	5	3	8	3	2	-	7	1	-	-	5	-	2	4	51	6	28	89	-	1	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-
2	-	1	-	1	1	2	-	20	2	12	3	17	1	13	4	64	6	43	117	-	6	1	5
55	-	8	5	116	2	4	-	126	1	21	3	101	-	13	19	1,061	5	128	1,213	-	1	-	7
12	1	10	-	-	-	-	3	27	2	4	5	34	1	6	18	150	6	47	221	1	2	-	-

CLASSIFICATION OF DISEASES

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division				Jamaica Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
External Causes:																				
—Continued																				
Traumatism by other crushing (vehicles, railways, landslides, etc.)	1	29	2	10	—	11	—	5	8	18	—	8	1	17	1	6	—	—	—	—
Traumatism by machines	—	9	1	—	—	1	—	—	—	—	—	—	—	5	1	3	1	—	1	—
Injuries by animals (not poisoning)	—	—	—	2	—	4	—	3	—	2	—	1	—	—	—	—	—	—	—	—
Over exertion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Starvation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Effects of heat	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lightning	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Electricity	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Homicide by firearms	—	—	—	—	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Homicide by cutting or piercing instruments	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	—	—	—
Homicide by other means	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Infanticide	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dislocations	—	1	—	1	1	1	—	—	—	3	—	2	—	2	1	—	—	—	—	—
Sprains	—	5	—	1	—	4	—	—	1	1	—	1	—	1	—	—	—	—	—	—
Fractures (cause not specified)	—	8	—	3	2	22	4	10	1	12	1	10	—	16	—	5	—	—	—	—
Other external violence:																				
Criminal abortion	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Explosions	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—
Salvarsan injection	—	—	—	—	—	—	—	—	3	66	—	—	—	—	—	—	—	—	—	—
Other medicaments (injections)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other external violence	—	—	—	—	1	68	1	1	2	122	—	24	4	50	1	18	—	—	—	—
Ill-Defined Diseases:																				
Sea sickness	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ill-defined organic diseases	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Sudden death	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—
No disease; malingering	1	10	—	2	—	14	1	48	1	16	8	58	5	3	4	37	—	—	—	—
Infections of undetermined origin	—	2	—	2	—	15	1	1	—	11	—	4	1	2	—	3	—	—	—	—
Snake bite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TOTALS	67	1,638	19	433	83	2,903	47	470	94	3,763	71	1,209	177	1,985	159	1,064	12	17	16	—

TREATED IN HOSPITALS—*Concluded*

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-total				Total	Deaths in Hospital			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.	Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.			T.	O.	
2	12	-	-	-	6	-	-	5	53	3	4	1	18	-	4	18	164	6	37	225	-	-	-	-
-	1	-	-	1	1	-	1	-	3	-	-	-	2	-	-	2	22	3	4	31	-	12	1	2
-	-	-	-	-	-	-	1	-	14	-	-	-	4	-	-	-	24	-	7	31	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	-	3	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	4	-	2	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	2	-	1	-	2	1	4	-	1	-	-	-	-	-	-	1	12	2	8	23	-	-	-	-
-	7	-	-	2	3	-	-	3	1	1	2	1	10	-	-	7	32	1	4	44	-	-	-	-
-	3	-	1	2	20	3	11	2	15	2	8	4	10	-	7	11	106	10	55	182	-	1	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	4	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	3	67	-	1	71	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	3	3	-	-	-	-
4	61	2	13	4	109	4	9	-	3	-	5	4	4	-	1	19	417	8	71	515	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	11	3	4	-	3	-	3	-	14	3	8	25	-	1	-	2
3	13	-	75	7	60	6	22	15	38	28	130	3	7	-	76	35	1	-	1	2	-	1	-	1
1	3	-	4	1	6	1	4	2	32	2	14	4	2	-	-	9	73	4	32	118	-	5	-	4
-	6	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	4	10	-	-	-	-
87	1,425	23	676	128	1,857	71	369	166	2,752	236	1,157	186	2,052	38	623	1,000	18,392	680	6,003	26,075	11	486	14	254

CLASSIFICATION OF DISEASES TREATED

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division				Jamaica Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Endemic or Infectious Diseases:																				
Malaria or cachexia (No. 5) . .	126	4,595	27	5,253	37	3,559	8	357	62	1,947	26	428	356	1,985	224	682	62	274	18	28
Influenza (No. 11)	70	916	36	717	30	3,164	11	327	31	541	18	103	52	158	14	84	26	409	22	38
Dysentery (No. 16)	-	53	-	14	9	1,752	16	412	7	249	-	79	-	1	-	-	3	9	-	7
Veneral infections (Nos. 38 to 40, inc.)	11	179	-	79	13	1,950	8	460	23	1,090	14	300	-	190	-	45	6	88	20	7
Other endemic or infectious diseases (Nos. 1 to 42, inc., excepting Nos. 5, 11, 16, and 38 to 40)	13	105	4	168	-	40	1	9	23	208	14	43	-	-	-	-	15	201	8	23
General Diseases Not Included Above:																				
Cancer (Nos. 43 to 49, inc.) . .	-	14	-	-	-	-	-	7	1	1	-	-	-	-	-	-	-	1	12	-
Benign tumors, and tumors not returned as malignant (No. 50)	6	16	-	8	-	-	-	-	-	4	1	-	-	-	-	-	-	1	-	-
Rheumatism or gout (Nos. 51 and 52)	14	356	6	198	2	1,123	-	55	44	1,083	15	109	56	213	24	59	8	145	20	7
Anemia, chlorosis (No. 58) . .	63	173	27	659	-	336	-	68	3	157	5	44	-	-	-	-	43	167	26	29
Other general diseases (Nos. 43 to 69, inc., excepting Nos. 43 to 52, inc., and No. 58) .	-	38	-	12	1	45	1	91	-	142	4	18	-	-	-	-	10	4	5	6
Diseases of the Nervous System and Organs of Special Sense:																				
Diseases of the nervous system (Nos. 70 to 84, inc.)	17	151	10	112	-	904	-	151	14	386	11	64	-	-	-	-	11	109	16	8
Diseases of the organs of vision and adnexa (No. 85)	22	302	24	144	-	584	-	48	24	424	4	76	35	70	12	25	19	87	13	17
Diseases of the organs of hearing and the mastoid process (No. 86)	17	93	10	93	7	119	3	73	9	121	2	20	7	56	1	13	12	30	25	24
Diseases of the Circulatory System:																				
Organic diseases of the heart (Nos. 87 to 90, inc.)	13	80	-	19	-	22	-	6	1	89	3	42	-	-	-	-	1	15	-	-
Other diseases of the circulatory system (Nos. 87 to 96, inc., excepting Nos. 87 to 90, inc.)	6	91	19	75	-	57	-	18	7	272	5	84	2	-	-	3	-	39	3	9
Diseases of the Respiratory System:																				
Bronchitis (No. 99)	159	1,217	32	889	7	1,612	1	172	64	1,033	30	176	76	211	39	65	-	1	-	-
Pneumonia and pleurisy (Nos. 100 to 102, inc.)	18	35	30	55	-	42	-	17	-	21	-	2	-	-	-	-	1	22	1	1
Other diseases of the respiratory system (Nos. 97 to 107, inc., excepting Nos. 99 to 102, inc.)	2	77	-	195	-	177	2	55	4	294	1	61	-	-	-	1	3	39	7	9
Diseases of the Digestive System:																				
Diseases of the mouth and adnexa (No. 108)	26	195	6	203	-	560	5	20	4	279	4	62	8	182	1	84	3	26	16	2
Diarrhea and enteritis (Nos. 113 and 114)	10	91	23	600	2	524	-	237	2	150	2	46	2	42	-	7	1	17	4	4
Ankylostomiasis (No. 115) . .	-	29	-	107	-	357	1	134	-	333	-	61	-	-	-	-	-	1	-	-
Other diseases of the digestive system (Nos. 108 to 127, inc., excepting Nos. 108 and Nos. 113 to 115, inc.) . . .	189	1,321	116	1,475	16	2,332	7	574	116	1,850	44	360	115	193	85	111	55	347	119	68

IN HOSPITAL DISPENSARIES

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Total				Total
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
46	777	18	687	56	573	18	1,139	353	1,267	298	579	37	433	13	151	1,135	15,410	650	9,304	26,499
16	4	4	7	35	178	8	288	112	243	87	139	1	—	3	1	373	5,613	203	1,704	7,893
—	7	—	4	—	3	—	2	10	95	7	36	5	4	10	5	34	2,173	33	559	2,799
5	1,084	2	502	51	135	16	59	185	834	97	424	25	389	6	80	319	5,939	163	1,956	8,377
1	26	1	3	1	29	—	42	—	37	—	15	—	3	—	46	53	649	28	349	1,079
—	—	—	17	—	—	—	8	—	—	—	—	—	—	—	—	1	16	12	32	61
7	6	—	5	—	1	—	—	—	—	—	—	5	24	—	10	18	52	1	23	94
11	260	2	44	6	82	—	72	2	37	—	11	5	61	5	12	148	3,360	72	567	4,147
1	45	1	53	—	12	8	84	—	5	1	6	—	7	1	7	110	902	69	950	2,031
—	2	—	—	22	109	19	217	124	297	89	171	—	—	1	2	157	637	119	517	1,430
20	83	9	24	9	157	4	127	34	131	11	46	18	83	14	51	123	2,004	75	583	2,785
19	47	—	51	53	363	22	123	56	263	21	106	41	169	13	70	269	2,309	109	660	3,347
15	22	5	34	1	13	2	40	13	70	7	33	24	45	2	44	105	569	57	374	1,105
3	20	—	37	—	18	—	37	5	40	1	20	—	2	1	4	23	286	5	165	479
4	41	—	24	1	11	—	28	91	227	69	129	2	5	4	21	113	743	100	391	1,347
24	247	4	67	58	355	7	425	30	215	10	90	53	166	23	96	471	5,057	146	1,980	7,654
—	20	1	9	1	8	—	11	6	75	3	28	—	7	—	14	26	230	35	137	428
6	54	2	14	15	51	1	100	90	191	55	105	74	576	13	125	194	1,459	81	665	2,399
11	87	3	25	5	108	3	138	24	130	12	55	14	168	5	44	95	1,735	55	633	2,518
3	10	2	13	3	38	8	318	2	36	4	42	10	34	10	29	35	942	53	1,296	2,326
1	2	2	30	—	—	—	—	6	81	14	52	—	1	—	1	7	804	17	385	1,213
56	280	20	145	115	709	27	1,019	202	786	154	387	150	560	80	216	1,014	8,378	652	4,355	14,399

CLASSIFICATION OF DISEASES TREATED

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division				Jamaica Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Non-Venereal Diseases of the Genito-Urinary System and its Adnexa:																				
Nos. 128 to 142, inc.	101	152	37	529	-	163	3	391	4	564	18	377	-	2	-	1	32	155	18	27
The Puerperal State:																				
Nos. 143 to 150, inc.	-	4	10	239	-	2	-	17	-	1	7	83	-	-	-	-	-	-	9	-
Diseases of the Skin and of the Cellular Tissue:																				
Boil, carbuncle, furuncle . . .	26	291	13	268	-	622	21	124	44	266	5	53	-	-	-	-	7	43	4	1
Phlegmon, acute abscess (No. 153)	29	879	19	800	7	849	3	160	1	112	-	35	3	191	-	122	13	81	5	24
Ground itch	-	3	-	6	-	-	-	-	-	28	-	3	-	-	-	-	-	-	-	-
Ulcer of the skin	5	476	16	65	-	2,961	-	34	25	121	-	13	11	580	-	109	-	25	1	-
Other diseases of the skin or cellular tissue, and adnexa, (Nos. 151 to 154, inc., excepting Nos. 152 and 153, and "Ground Itch" and "Ulcer of the Skin") . . .	42	819	56	539	4	864	6	117	68	847	19	139	99	72	27	15	22	60	22	19
Diseases of the Bones and Organs of Locomotion:																				
Nos. 155 to 158, inc.	2	50	6	41	-	87	-	9	1	16	2	1	-	-	-	-	-	4	7	-
Malformations:																				
No. 159	-	-	-	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Diseases of Early Infancy:																				
Nos. 160 to 163, inc.	-	-	-	32	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Old Age:																				
No. 164	-	6	-	2	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-
External Causes:																				
Injury by firearms (No. 183) . .	-	8	-	-	-	5	-	-	-	8	-	2	-	-	-	-	-	-	-	-
Injury by cutting or piercing instruments and falls (Nos. 184 and 185)	224	4,297	43	530	3	1,174	3	61	45	837	7	100	12	270	1	86	10	333	22	10
Traumatism by machines and other means (Nos. 187 and 188)	143	633	36	80	-	1,308	-	16	11	236	3	10	-	-	-	-	8	434	12	2
Dislocations, sprains, fractures (No. 201)	30	210	23	105	-	6	-	7	7	111	5	12	-	-	-	-	12	56	5	3
Other external causes (Nos. 165 to 203, inc., excepting Nos. 183 to 185, inc., 187, 188, and 201)	38	158	20	93	-	235	-	28	70	1,032	9	189	22	116	1	33	3	43	52	680
Ill-Defined Diseases:																				
Nos. 204 and 205	-	58	-	32	-	39	-	144	5	87	2	371	-	-	-	-	4	10	154	215
TOTALS	1,427	18,171	649	14,489	138	27,574	100	4,398	720	14,947	280	3,569	856	4,532	429	1,545	390	3,276	646	1,268

N HOSPITAL DISPENSARIES—*Concluded*

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Total				Total
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
2	145	13	201	5	64	29	228	41	184	86	207	24	49	29	129	226	1,478	233	2,090	4,026
-	1	-	6	-	-	1	46	-	-	-	-	-	-	1	19	-	8	28	410	447
21	5	-	14	5	19	-	19	120	206	83	137	35	276	24	117	258	1,728	150	733	2,869
10	79	5	109	37	427	47	144	144	256	119	158	24	137	24	106	268	3,011	222	1,658	5,159
-	-	-	2	-	3	-	7	22	120	16	59	10	8	-	25	32	162	16	102	312
5	46	6	38	8	310	-	149	58	636	42	260	13	207	34	35	125	5,362	99	703	6,289
33	305	41	240	65	303	51	498	371	783	302	475	225	384	45	158	959	4,437	569	2,200	8,165
15	63	2	89	1	25	6	18	5	55	3	13	19	206	4	19	43	506	30	190	769
-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	7	7
-	-	-	22	-	-	-	38	-	-	-	6	-	1	-	3	-	1	-	103	104
-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	14	-	5	19
-	2	-	2	-	-	-	-	19	111	11	89	3	3	-	24	22	137	11	117	287
-	19	1	24	92	2,113	60	320	46	258	27	113	63	279	3	22	495	9,580	167	1,316	11,558
3	11	1	-	-	400	-	1	2	18	-	1	7	89	-	2	179	3,129	52	111	3,471
8	15	8	11	6	15	6	16	9	78	1	26	35	40	4	14	107	531	52	194	884
37	329	15	66	117	1,322	10	184	5	35	1	7	6	55	1	43	298	3,325	109	1,323	5,055
36	2,510	256	1,397	6	25	4	61	94	154	67	86	256	138	130	241	851	3,021	613	2,547	7,032
16	6,655	424	4,016	774	7,979	357	6,011	2,281	7,954	1,698	4,111	1,184	4,609	503	1,987	8,686	95,697	5,086	41,394	150,863

SURGICAL REPORT

BONES, OPERATIONS ON:

Skull, fracture of
 Craniectomy, decompressive
 Bone graft
 Fractures, simple
 Fractures, comminuted
 Fractures, compound
 Operations for reduction of fractures
 Osteotomy
 Osteectomy
 Resection of maxilla
 Resection of shoulder
 Resection of elbow
 Resection, others
 Wire suture of patella
 Wire suture of clavicle
 Radical cure of Morton's disease
 Others

CHEST, OPERATIONS ON:

Breast, abscess, incision of
 Breast, excision of
 Breast and axilla, excision of
 Thoracotomy
 Others

LAPAROTOMY:

Abdomen, penetrating wound of
 Abscess of liver, laparo-hepatotomy
 Abscess of liver, thoraco-hepatotomy
 Appendectomy with local peritonitis
 Appendectomy with general peritonitis
 Cholecystectomy

	Banes Div.	Colom- bia Div.	Costa Rica Div.	Guate- mala Div.	Jama- ica Div.	Pana- ma Div.	Pres- ton Div.	*Tela R.R.	Trux- illo R.R.	Total	*Post Opera- tive Deaths
	-	-	-	1	-	-	-	7	-	8	-
	1	-	-	1	-	-	-	-	-	2	1
	-	-	-	-	-	2	-	1	-	3	1
	25	8	27	16	7	4	16	23	19	145	-
	8	-	1	-	1	1	1	8	7	26	3
	4	-	2	7	1	-	-	13	8	35	1
	6	11	2	1	-	1	9	1	2	33	-
	2	3	1	1	-	1	3	1	3	14	-
	3	1	1	5	-	1	1	8	-	20	-
	-	-	-	1	-	-	-	-	-	1	-
	1	-	-	-	-	-	1	-	-	1	-
	-	-	-	-	-	-	-	-	1	4	-
	-	-	-	1	-	3	-	-	-	1	-
	-	-	-	1	-	-	-	-	-	1	-
	-	-	-	1	-	-	-	-	-	1	-
	-	7	6	-	-	1	7	-	2	28	-
	1	3	-	1	3	-	1	4	2	15	-
	-	-	-	-	-	-	1	-	-	1	-
	-	-	-	-	-	-	1	-	-	1	-
	-	3	-	3	1	-	2	1	3	13	2
	-	7	-	-	-	1	-	-	12	20	-
	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	3	-	-	1	7	-	11	-
	-	-	1	1	-	-	-	-	1	3	1
	-	-	-	-	-	-	-	1	2	3	-
	14	21	12	25	-	8	33	12	5	130	4
	24	2	3	-	1	-	-	6	-	36	-
	-	4	3	1	-	-	2	-	-	10	1

NOTE: The Surgical Report for 1926 (on page 334) erroneously showed 10 operations for abscess of the liver (thoraco-hepatotomy) in the Tela R. R. Company Hospital, and these were included also in the "Total" column. The 10 operations just named, however, were for the treatment of ordinary abscesses and should have been entered on page 337, opposite the head MISCELLANEOUS: Abscesses, treatment of.

Cholecystotomy	2	1	—	—	1	2	—	—	8
Choledochotomy	—	—	—	—	—	1	—	—	1
Colostomy	1	—	—	—	—	—	1	—	2
Ectopic gestation	3	1	—	1	—	—	—	1	10
Enterectomy	1	—	—	—	—	—	—	—	1
Entero-enterostomy	1	1	—	—	—	—	—	—	3
Enterorrhaphy	3	—	—	—	—	—	—	—	3
Exploratory	10	2	—	4	4	7	2	3	32
Gastro-enterostomy	—	1	—	—	—	—	—	—	1
General peritonitis	1	—	—	—	—	—	—	—	4
Hysterectomy supravaginal	17	2	—	3	8	4	2	4	40
Pan-hysterectomy	2	1	—	—	1	1	—	—	5
Hystero-myomectomy	3	—	—	2	—	—	4	—	9
Hysteropexy	—	—	—	7	1	2	4	2	16
Hysteropexy with perineorrhaphy	2	—	—	—	—	—	1	2	5
Intestinal obstruction	—	—	—	—	—	1	—	—	3
Intussusception, treatment of	1	—	—	—	—	—	—	—	1
Myomectomy	4	—	—	—	—	—	5	—	10
Ovarian cystectomy	4	2	—	3	—	—	4	—	16
Oophorectomy	11	—	—	1	2	8	—	—	26
Paracentesis abdominalis	28	—	—	2	4	—	4	—	38
Salpingectomy	8	1	—	2	4	7	—	—	34
Salpingo-oophorectomy	1	2	—	3	12	9	3	4	39
Bartholincotomy	—	—	—	—	—	1	—	—	1
Others	2	2	—	—	—	12	—	—	16

OBSTETRICAL:

Abortions	17	3	—	—	—	5	10	7	8	50
Births, premature	5	2	—	—	—	—	5	2	5	21
Births, normal	29	31	19	—	—	48	15	74	39	289
Births, multiple	—	—	1	—	—	—	—	—	—	1
Births, forceps operations	6	6	—	—	—	1	1	5	—	19
Births, abnormal presentations	3	1	—	—	—	—	—	3	2	9
Births, episiotomy	—	—	1	—	—	—	—	8	2	11
Births, versions	2	2	—	—	—	1	1	3	—	9
Births, Caesarian	—	1	—	—	—	—	1	—	—	2
Craniotomy and extraction	—	—	—	—	—	—	2	—	—	2
Repairs of perineum	3	—	—	—	—	—	—	—	—	3
Others	—	1	4	—	—	1	1	5	1	14

SURGICAL REPORT—Continued

GENTO-URINARY TRACT:

	Banes Div.	Colom- bia Div.	Costa Rica Div.	Guate- mala Div.	Ja- maica Div.	Pana- ma Div.	Pres- ton Div.	*Tela R.R.	Trux- illo R.R.	Total	*Post Opera- tive Deaths
Chancroid operations	5	35	799	—	—	—	—	39	3	881	—
Circumcisions	3	28	12	30	—	24	14	9	12	132	—
Curettagc uteri	11	34	5	17	—	1	2	14	2	86	—
Cystotomy	—	—	2	1	—	—	5	2	—	10	2
Epididymectomy	—	—	1	—	—	—	—	—	—	1	—
Epididymotomy	—	—	1	—	—	—	—	1	—	2	—
Hydrocele, single, radical cure	1	5	5	3	4	2	12	4	1	37	1
Hydrocele, double, radical cure	—	1	2	—	—	—	2	1	—	6	—
Nephrectomy	—	1	—	—	—	2	—	—	—	3	—
Orchidectomy	—	—	5	—	—	1	4	—	—	10	—
Penis, operations on	—	3	8	10	—	—	2	27	1	51	—
Perineorrhaphy	1	10	—	4	—	—	1	5	—	21	—
Perinephritic abscess	—	—	—	—	—	—	1	1	1	2	—
Prostatectomy	—	—	—	—	—	—	1	1	—	2	—
Scrotum operations	—	2	1	—	—	3	1	—	—	7	—
Vaginal puncture for pelvic cellulitis	—	2	—	—	—	—	—	1	—	3	—
Vaginal operations	1	18	—	7	—	8	—	—	—	34	—
Varicocele, radical cure	—	3	—	1	—	—	—	—	—	4	—
Urethrotomy, internal	1	1	4	2	2	3	—	1	12	26	—
Urethrotomy, external	1	2	4	1	—	2	6	3	—	18	—
Others	—	12	718	—	—	—	16	5	42	793	1

HERNIOTOMY:

Epigastric	—	—	—	—	—	—	3	—	—	3	—
Femoral	—	2	—	—	—	—	—	1	—	3	1
Inguinal, single	4	53	7	11	—	14	13	9	14	125	1
Inguinal, double	2	4	—	—	—	2	—	4	1	13	—
Strangulated	2	1	—	—	—	1	—	—	1	5	2
Umbilical	2	—	—	2	—	—	1	—	—	3	—
Ventral	—	5	—	—	—	—	—	—	—	7	—
Combined	—	—	—	—	—	—	—	1	—	1	—
Others	—	4	—	—	—	—	3	—	—	7	—

ADENECTOMY:

Axillary	3	1	-	-	-	-	4	-
Cervical	-	1	-	-	-	-	8	-
Femoral	-	12	1	-	-	12	28	-
Inguinal, single	7	67	329	1	4	17	459	-
Inguinal, double	-	9	7	-	-	4	23	-
Others	3	2	-	-	-	-	5	-

AMPUTATIONS:

Hand	-	2	-	-	-	1	4	-
Forearm	2	-	1	-	-	3	6	-
Breast	-	-	-	-	2	-	2	-
Arm	1	3	1	1	-	2	9	-
Thigh	4	-	-	-	-	-	7	-
Leg	1	2	4	-	-	1	13	-
Foot	-	-	2	-	1	2	5	-
Digits, multiple	5	5	18	-	6	9	61	-

JOINTS, OPERATIONS ON:

Arthrotomy	2	1	-	-	-	7	17	1
Reduction of location	37	3	4	3	2	6	61	-
Others	-	-	11	-	-	1	22	-

MUSCLES AND TENDONS, OPERATIONS ON:

Tenorrhaphy	1	4	4	-	1	2	30	-
Others	-	1	1	-	-	-	4	-

RECTUM, OPERATIONS ON:

Fistula in ano	2	5	5	-	-	1	19	-
Hemorrhoids	1	19	12	2	12	14	71	-
Ischio-rectal abscess	2	1	2	-	-	1	12	-
Prolapsus recti	-	-	-	-	-	1	1	-
Others	1	4	-	-	-	1	8	-

SURGICAL REPORT—*Concluded*

MISCELLANEOUS:

	Banes Div.	Colom- bia Div.	Costa Rica Div.	Guate- mala Div.	Ja- maica Div.	Pana- ma Div.	Pres- ton Div.	*Tela R.R.	Trux- illo R.R.	Total	*Post Opera- tive Deaths
Abscesses, treatment of	316	470	557	401	77	113	218	212	283	2,647	5
Aneurism, operation for	—	—	—	—	—	3	—	1	—	4	—
Blood transfusions	—	1	—	—	—	—	—	5	—	6	—
Carbuncles, treatment of	96	83	309	7	4	2	6	50	11	568	1
Cysts	2	6	28	5	1	10	9	1	3	65	—
Elephantiasis, treatment of	—	—	—	—	—	—	2	—	—	2	—
Fistulous tracts	—	4	2	—	—	—	—	—	—	6	—
Injections, intravenous	264	3,655	1,671	617	2	2,336	845	1,092	652	11,134	—
Nails, extirpation of	8	3	13	4	4	—	4	—	6	42	—
Neoplasm, excision of, benign	—	—	—	5	—	—	2	14	5	26	—
Neoplasm, excision of, malignant	—	—	—	—	—	—	1	7	1	9	—
Plastic operations for severe injuries	—	—	—	1	—	—	—	1	1	3	—
Plastic operations for effects of disease	—	—	2	—	—	—	—	1	1	7	—
Plastic operations for congenital defects	—	2	—	1	—	—	—	—	2	5	—
Removal of foreign body	8	3	11	9	4	4	13	2	3	57	—
Resection, meningocele	—	—	—	—	—	—	—	—	1	1	—
Skin graft	—	3	—	—	—	—	—	—	8	11	—
Snake bite, treatment of	—	—	4	7	—	—	1	6	2	20	—
Thyroidectomy	1	—	—	19	—	—	—	1	—	21	—
Tooth extraction	115	365	557	333	15	120	196	47	159	1,907	—
Ulcers, treatment of	103	26	2,016	397	—	1	204	98	64	2,909	—
Vaccinations	11,163	—	129	—	673	89	149	1	66	12,270	—
Varicose veins, treatment of	—	15	—	—	—	—	—	2	—	17	—
Wounds, gunshot	7	—	2	12	—	4	2	40	18	85	2
Wounds, scalds and burns	57	33	35	2	—	—	32	7	1	167	—
Wounds, stab	1	—	—	3	—	—	4	54	7	69	—
Wounds, other	1,337	26	2,635	333	13	42	1,140	115	78	5,719	2
Various other minor operations	12	26	295	3	1	118	2	215	44	716	3
Various other major operations	—	24	2	1	—	—	—	1	1	29	—

EAR, OPERATIONS ON:

Abscess, incision of	—	—	1	—	—	2	—	4
Mastoid operations	—	1	1	—	—	—	3	5
Paracentesis of membrane tympani	5	—	—	—	—	1	2	8
Removal of foreign bodies	—	88	54	1	2	35	—	180
Others	—	1	—	—	—	—	2	3

EYE, OPERATIONS ON:

Abscess, incision of	—	1	—	1	—	—	—	2
Cataract, extraction of	—	—	—	—	2	—	—	3
Chalazion, excision of	—	—	1	—	—	—	3	4
Enucleation	—	4	—	—	1	—	1	9
Hordeolum	—	—	—	2	—	—	3	6
Lid operations	—	—	—	2	—	—	2	4
Pterygium, excision of	—	5	—	—	—	—	—	5
Removal of foreign body	46	11	11	194	5	164	11	392
Pterygium, transplantation of	—	—	—	—	—	—	1	8
Trachoma, treatment of	—	—	—	4	—	1	—	5
Others	22	3	—	4	—	—	5	34

NOSE AND THROAT, OPERATIONS ON:

Adeno-tonsillectomy	—	1	15	—	—	15	13	7	55
Peritonsillar abscess, incision of	—	—	1	—	—	—	—	3	6
Removal of polypi	4	1	—	1	—	—	—	—	6
Sinus operations	—	1	—	—	—	1	—	1	3
Tonsillectomy	4	21	3	3	—	4	1	10	59
Others	—	1	1	—	—	—	—	2	5
GRAND TOTAL	13,884	5,350	2,523	829	3,089	3,313	2,496	1,737	43,824
									55

* NOTE. — The Tela Railroad Company's Hospital does not report post-operative deaths. In consequence, the "Total" column shows the number of operations in nine Divisions, whereas the "Post-operative Deaths" only includes *eight* Divisions. Under the circumstances a comparison of the two columns does not give an accurate idea of the fatality rate following the respective classes of operations, but the table will give a general idea of the mortality caused by the conditions necessitating surgical attention.

	Banes Division				Colombia Division				Costa Rica Division				Guatemala Division			
	Hosp. Total	Pos.	Hosp. Disp. Total	Pos.	Hosp. Total	Pos.	Hosp. Disp. Total	Pos.	Hosp. Total	Pos.	Hosp. Disp. Total	Pos.	Hosp. Total	Pos.	Hosp. Disp. Total	Pos.
BLOOD EXAMINATIONS:																
Total examinations	2398	-	617	-	4606	-	957	-	4739	-	335	-	3806	-	1042	-
Leucocyte enumerations	100	-	28	-	133	-	13	-	140	-	40	-	105	-	4	-
Differential leucocyte counts	19	-	-	-	13	-	4	-	58	-	26	-	81	-	4	-
Erythrocyte enumerations	7	-	5	-	4	-	4	-	55	-	33	-	40	-	1	-
Hemoglobin estimations	26	-	3	-	3554	-	756	-	4383	-	174	-	35	-	1	-
Malaria	2144	-	570	-	4138	-	902	-	1953	-	148	-	3545	-	1032	-
(a) Estivo-autumnal	-	600	-	67	-	464	-	113	-	674	-	59	-	1157	-	335
(b) Tertian	-	68	-	44	-	303	-	77	-	700	-	41	-	269	-	96
(c) Quartan	-	25	-	5	-	11	-	1	-	22	-	9	-	37	-	3
(d) Mixed infection	-	7	-	3	-	10	-	2	-	21	-	6	-	15	-	4
Widal tests	57	34	11	6	125	44	18	6	39	-	15	-	-	-	-	-
Other examinations	45	37	-	-	193	3	16	-	54	-	25	-	-	-	-	-
URINE EXAMINATIONS:																
Total examinations	2056	-	378	-	4128	-	903	-	4966	-	835	-	4612	-	407	-
Albumin	1977	244	-	46	-	2135	-	339	-	859	-	151	4610	1480	407	63
Casts	-	88	-	8	-	1230	-	137	-	96	-	23	-	974	-	42
Pus	-	62	-	17	-	981	-	231	-	882	-	157	-	1105	-	49
Blood	-	29	-	7	-	1450	-	237	-	55	-	13	-	66	-	3
Sugar	-	3	-	20	4120	24	817	30	-	22	-	38	-	5	-	13
Hemoglobin	-	31	-	-	1	1	-	-	-	53	-	5	-	23	-	-
Gonococci	-	-	-	-	5	3	8	5	-	6	-	11	-	-	-	-
B. tuberculosis	-	-	-	-	3	-	4	-	-	-	-	-	-	-	-	-
Other examinations	48	48	-	-	296	283	42	28	-	64	-	23	2	36	-	-
SPUTUM EXAMINATIONS:																
Total examinations	60	-	20	-	523	-	152	-	167	-	88	-	469	-	36	-
B. tuberculosis	-	14	-	3	-	42	-	31	-	25	-	16	466	38	36	6
Pus	-	3	-	-	469	-	117	-	55	-	22	-	13	-	-	1
Blood	-	3	-	1	-	30	-	11	-	32	-	12	-	11	-	1
Other examinations	-	2	-	1	5	1	-	1	-	29	-	12	3	1	-	-
STOOL EXAMINATIONS:																
Total examinations	1847	-	483	-	3517	-	684	-	5825	-	1047	-	3747	-	215	-
Uncinaria	-	248	-	48	-	2390	-	113	-	2693	-	387	3747	1619	215	49
Trichuris	-	317	-	201	-	2108	-	200	-	474	-	109	-	1462	-	42
Ascaris	-	364	-	69	-	768	-	90	-	129	-	48	-	1518	-	53
Oxyuris vermicularis	-	7	-	4	-	-	-	6	-	6	-	3	-	2	-	-
Strongyloides stercoralis	-	33	-	9	-	187	-	25	-	25	-	12	-	211	-	5
Taenia saginata	-	1	-	2	-	2	-	-	-	3	-	2	-	7	-	-
Taenia solium	-	-	-	-	-	-	-	-	-	-	-	2	-	3	-	-
Other tape-worms	-	-	-	-	15	-	3	-	12	-	2	-	-	-	-	-
Entamoeba histolytica	-	29	-	9	-	818	-	255	-	76	-	40	-	140	-	2
Other entamoebae	-	38	-	16	-	231	-	46	-	66	-	32	-	14	-	-
Balantidium coli	-	4	-	2	-	26	-	-	-	3	-	13	-	44	-	1
Flagellates, intestinal	-	30	-	10	-	779	-	167	-	95	-	53	-	117	-	9
Blood	-	32	-	4	-	222	-	54	-	75	117	35	-	200	-	6
Pus	-	23	-	4	-	220	-	57	-	65	-	22	-	193	-	6
Other examinations	-	11	-	-	2	-	-	1	-	55	-	25	-	23	-	-
Clonorchis sinensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Schistosoma mansoni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MISCELLANEOUS SMEARS:																
Total examinations	33	-	15	-	166	-	293	-	386	3	169	-	352	-	126	-
Eye	-	-	-	-	21	10	7	2	-	24	-	11	95	52	3	1
Throat	2	-	1	-	5	3	20	11	-	7	-	4	-	-	-	-
Gums and mouth	-	-	-	-	5	4	-	-	-	3	-	1	-	-	-	-
Nose	-	-	-	-	30	5	28	10	2	4	1	7	4	-	1	-
Ear	-	-	-	-	-	-	3	1	1	3	1	6	6	2	-	-
Genital source (gonococcus)	12	6	5	4	42	21	181	69	11	70	7	44	247	135	121	63
Cutaneous ulcer	4	1	-	-	7	2	4	2	10	27	2	10	-	-	1	1
Other smears	9	1	9	8	59	7	49	7	8	41	4	42	-	-	-	-
Spinal fluid for meningococcus	6	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

LABORATORY REPORT

Jamaica Division				Panama Division				Preston Division				Tela Railroad				Truxillo Railroad			
Hosp. Total Pos.		Hosp. Disp. Total Pos.		Hosp. Total Pos.		Hosp. Disp. Total Pos.		Hosp. Total Pos.		Hosp. Disp. Total Pos.		Hosp. Total Pos.		Hosp. Disp. Total Pos.		Hosp. Total Pos.		Hosp. Disp. Total Pos.	
6	-	55	-	8859	-	2681	-	3587	-	1594	-	10108	-	-	-	4835	-	935	-
-	-	1	-	340	-	20	-	163	-	25	-	553	-	-	-	224	-	14	-
1	-	2	-	258	-	10	-	74	-	8	-	87	-	-	-	224	-	24	-
-	-	-	-	21	-	2	-	3	-	-	-	15	-	-	-	44	-	1	-
-	-	12	-	2130	-	790	-	42	-	7	-	397	-	-	-	86	-	30	-
5	-	40	-	6105	-	1859	-	3297	-	1554	-	8780	-	-	-	4245	-	866	-
-	-	-	1	-	1033	-	195	-	1178	-	542	-	2450	-	-	-	1184	-	164
-	3	-	17	-	526	-	89	-	83	-	27	-	536	-	-	-	196	-	47
-	-	-	-	-	39	-	4	-	31	-	37	-	50	-	-	-	58	-	9
-	-	-	-	-	44	-	1	-	12	-	4	-	54	-	-	-	57	-	5
-	-	-	-	2	2	-	-	8	5	-	-	137	19	-	-	-	-	-	-
-	-	-	-	3	3	-	-	-	13	-	4	139	-	-	-	2	2	-	-
12	2	453	49	3794	-	671	-	2880	-	486	-	5701	-	-	-	3407	-	400	-
4	1	194	13	-	1350	-	136	-	831	-	117	-	988	-	-	-	1413	-	120
1	1	3	3	-	572	-	91	-	361	-	39	-	998	-	-	-	468	-	25
-	-	9	8	-	3446	-	541	-	731	-	146	1	1091	-	-	-	1535	-	231
4	-	1	-	-	369	-	69	-	96	-	28	-	241	-	-	-	217	-	33
3	-	186	7	-	8	-	1	-	3	-	7	-	4	-	-	-	-	-	3
-	-	-	-	-	5	-	-	-	10	-	-	-	9	-	-	-	58	-	-
-	-	-	-	-	-	-	-	1	1	-	-	-	61	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
-	-	60	18	3797	52	-	12	14	14	-	-	-	65	-	-	56	56	3	3
1	-	3	-	215	-	12	-	121	-	27	-	471	-	-	-	407	-	13	-
1	-	3	1	-	12	12	-	-	22	-	4	471	88	-	-	-	58	-	-
-	-	-	-	-	5	-	-	9	9	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	3	-	-	-	6	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	10	9	-	-	-	-	-	-	6	5	-	-
-	-	29	-	3065	-	193	-	990	-	78	-	4982	-	-	-	3536	-	67	-
-	-	24	1	-	694	193	54	-	247	-	17	-	1517	-	-	-	1629	-	19
-	-	-	-	-	744	193	93	-	118	-	12	-	2118	-	-	-	954	-	19
-	-	-	2	-	193	193	29	-	73	-	4	-	1877	-	-	-	442	-	15
-	-	-	-	-	1	193	1	-	-	-	-	-	-	-	-	-	1	-	-
-	-	-	-	-	94	193	2	-	33	-	-	-	217	-	-	-	-	-	-
-	-	-	-	-	2	-	-	-	1	-	-	-	8	-	-	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	3	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-
-	-	1	1	-	15	-	-	-	61	-	3	-	268	-	-	-	50	-	-
-	-	-	-	-	41	193	2	-	19	-	3	-	667	-	-	-	-	-	-
-	-	-	-	-	3	-	-	-	3	-	-	-	18	-	-	-	-	-	-
-	-	-	-	-	67	193	5	-	24	-	1	-	423	-	-	-	-	-	-
-	-	4	3	-	14	193	1	-	70	-	7	-	241	-	-	-	223	-	-
-	-	-	-	-	78	193	5	-	53	-	5	-	167	-	-	-	282	-	-
-	-	-	-	3071	71	193	4	-	-	-	-	-	685	-	-	27	27	1	1
-	-	-	-	-	-	-	-	5	5	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
1	-	1	-	97	-	51	-	30	-	20	-	458	-	-	-	210	-	47	-
-	-	-	-	7	5	2	2	1	1	-	-	61	27	-	-	8	7	2	-
-	-	-	-	1	1	-	-	1	1	-	-	11	5	-	-	4	2	2	1
-	-	-	-	5	3	2	1	-	-	-	-	6	6	-	-	1	1	-	-
-	-	-	-	-	-	-	-	3	1	1	-	-	-	-	-	2	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
-	-	1	-	78	37	46	21	13	13	19	6	557	135	-	-	83	43	40	18
-	-	-	-	1	1	1	1	-	-	-	-	7	5	-	-	3	1	1	-
1	-	-	-	5	3	-	-	12	11	-	-	15	8	-	-	109	57	2	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUMBER AND CLASSIFICATION OF X-RAY EXAMINATIONS

Nature of Examination	Banes Division		Columbia Division		Costa Rica Division		Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		*Total	
	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used	Number of Examinations	Plates and Films used		
Vertebral column	5	8	13	23	6	12	7	8	—	—	4	9	11	14	13	?	6	12	65	86
Skull	6	7	32	51	24	26	23	32	—	—	3	8	11	14	46	?	16	26	161	164
Sternum	—	—	2	5	—	—	1	1	—	—	—	—	—	—	—	—	—	—	3	6
Ribs	4	5	12	16	—	—	15	21	—	—	2	3	2	2	2	?	12	17	49	64
Hyoid bone	—	—	—	—	—	—	—	—	—	—	2	4	—	—	—	—	—	—	2	4
Upper limbs	70	89	67	103	103	134	100	154	—	—	36	62	80	87	105	?	63	76	624	705
Lower limbs	40	52	101	180	115	156	109	139	—	—	54	86	92	106	97	?	77	97	685	816
Neck	2	2	—	—	—	—	2	3	—	—	3	6	—	—	5	?	—	—	12	11
Teeth	7	13	25	79	26	89	1	1	—	—	32	76	12	22	2	?	7	11	112	291
Heart	7	?	2	2	3	5	6	6	—	—	—	—	8	9	679	?	7	9	712	31
Lungs	68	49	44	11	44	54	102	125	—	—	17	29	54	57	723	?	79	86	1,131	411
Liver	12	4	4	4	—	—	1	1	—	—	—	—	2	2	4	?	1	1	24	12
Spleen	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kidney	1	2	20	35	—	—	—	—	—	—	2	2	4	6	20	?	2	2	49	47
Gastro-intestinal tract	12	28	33	82	6	21	10	18	—	—	—	—	12	30	66	?	3	7	142	186
Pelvic organs	4	4	25	31	10	11	15	20	—	—	4	3	5	6	23	?	1	1	87	76
Miscellaneous	—	—	62	—	—	—	3	5	—	—	6	9	9	9	67	?	11	4	158	27
TOTAL	258	263	442	622	337	508	395	534	—	—	165	297	302	364	1,852	287	285	349	4,016	3,224

*NOTE. — The figures appearing in the Total column, under the heading "Plates and Films used," are incomplete, inasmuch as the Tela Railroad Company's Medical Department has not supplied sufficient data in their reports to record the number of plates and films used in the Tela Hospital in examining the respective organs. Fluoroscopic examinations are included in the columns entitled "No. of examinations."

METEOROLOGICAL REPORT

AVERAGE TOTAL RAINFALL (INCHES)

MONTH:	Banes Division	Colombia Division	Costa Rica Division	Guatemala Division	Jamaica Division	Panama Division	Preston Division	Tela Railroad	Truxillo Railroad	Average for All Divisions
January	6.16	.00	25.93	12.79	6.12	29.38	5.19	11.21	18.16	—
February . . . . .	.36	.20	6.43	2.98	2.58	9.14	.62	2.02	2.84	—
March . . . . .	.38	.65	5.16	4.31	1.37	6.57	.30	5.01	1.41	—
April . . . . .	.76	1.62	8.83	1.01	4.59	7.95	1.07	.31	.58	—
May	2.78	5.67	13.00	4.98	5.75	15.07	6.17	1.77	2.53	—
June . . . . .	.55	10.29	11.58	10.51	4.36	13.94	1.33	3.82	5.56	—
July	2.92	4.88	11.03	13.82	7.36	6.32	3.66	9.18	8.82	—
August	2.62	4.47	7.73	15.76	4.11	9.81	2.30	12.69	12.49	—
September	6.76	13.42	4.60	12.42	4.15	3.36	5.93	9.86	5.48	—
October	6.95	17.38	10.37	6.57	12.20	9.30	8.62	5.63	7.87	—
November	6.01	3.77	16.24	13.51	6.89	12.36	6.79	20.50	31.31	—
December	1.67	2.44	24.50	4.04	1.85	25.95	1.88	4.35	5.33	—
TOTALS	37.92	64.79	145.40	102.70	61.23	149.15	43.86	86.35	102.38	88.20

MEAN TEMPERATURE (FAHRENHEIT)

January	68.00	80.00	73.00	72.00	72.00	78.00	66.00	74.25	74.50	—
February	73.35	80.00	73.50	78.00	72.50	79.00	72.50	78.00	80.00	—
March	74.20	81.00	73.00	76.50	72.00	80.00	70.50	77.50	80.50	—
April	74.35	81.50	75.00	80.00	74.50	78.50	72.50	80.50	81.00	—
May	77.00	82.00	76.00	81.00	75.50	79.50	74.50	83.00	83.00	—
June	80.20	83.00	75.50	78.00	77.00	80.50	77.00	83.60	81.00	—
July	80.15	83.50	75.00	78.00	77.50	80.00	78.50	82.35	79.50	—
August	79.50	82.00	76.50	79.00	77.00	86.00	77.50	82.80	80.00	—
September	79.80	80.50	77.00	78.50	77.50	81.00	78.50	81.45	80.00	—
October	78.15	81.00	76.00	78.00	78.00	81.00	79.00	79.00	78.50	—
November	76.95	81.00	76.00	77.00	76.00	79.50	76.50	76.60	73.50	—
December	69.80	81.00	74.00	82.00	74.00	77.50	70.50	76.50	73.00	—
Average maximum temperature	91.35	92.25	86.08	96.25	86.92	88.83	93.33	88.52	84.42	—
Average minimum temperature	60.56	70.50	64.00	60.08	63.67	71.25	55.58	70.74	73.00	—
Average mean temperature	75.95	81.98	75.04	78.17	75.29	80.04	74.46	79.63	78.71	—

GENERAL STATEMENT PASSENGER SERVICE

NEW YORK PASSENGER STEAMSHIPS

	Calamares	Car-rillo	Meta-pan	Pas-tores	Santa Marta	Six-aola	Tivives	Tolosa	Ulua	Zacapa	Grand Total
Number of voyages made	12	13	13	13	13	13	13	13	13	13	129
Total number of officers, all voyages	264	250	248	286	250	249	251	297	294	248	2,637
Total number in crews, all voyages	1,186	890	884	1,315	884	887	886	1,359	1,355	884	10,530
Total number of ships' laborers, all voyages	187	220	205	189	203	223	216	193	205	251	2,092
Number of seamen given physical examination before "signing-on,"	1,246	904	887	1,301	889	828	892	1,362	1,340	890	10,539
Number of rejected applicants, "signing-on" day	18	14	3	6	8	2	7	12	12	2	84
Number of persons rejected at tropical ports	—	—	—	—	—	—	—	—	—	—	—
Number of cabin passengers carried	2,932	2,579	2,339	3,251	2,845	3,005	2,806	3,354	3,056	2,427	28,594
Number of deck passengers carried	381	885	640	427	901	771	887	429	402	647	6,370

OFFICERS, CREWS, AND SHIPS' LABORERS:

Total number of patients treated	488	398
Total number of treatments in office	858	890
Total number of treatments in quarters	88	50

PASSENGERS:

Total number of patients treated	132	182	69	50	116	149	99	160	124	112	1,193
Total number of treatments in office	179	318	65	57	131	210	73	178	110	149	1,470
Total number of treatments in staterooms	61	80	72	93	72	134	162	168	116	68	1,026
Number of vaccinations	27	182	373	24	277	179	128	13	20	292	1,515
Number of persons detained by quarantine and immigration authorities	13	10	6	3	4	8	10	14	7	11	86
*Number of deaths	2	1	—	—	—	—	2	—	—	1	6

*The deaths aboard steamships of the New York Division were caused by: heart failure, 4; fracture of spinal vertebrae, 1; suicide, 1.

NEW ORLEANS PASSENGER STEAMSHIPS

Number of voyages made
Total number of officers, all voyages
Total number in crews, all voyages
Total number of ships' laborers, all
voyages
Number of seamen given physical
examination before "signing-on" .
Number of rejected applicants,
"signing-on" day
Number of persons rejected at trop-
ical ports
Number of cabin passengers carried
Number of deck passengers carried .

OFFICERS, CREWS, AND SHIPS'

LABORERS:

Total number of patients treated .
Total number of treatments in
office
Total number of treatments in
quarters

PASSENGERS:

Total number of patients treated .
Total number of treatments in
office
Total number of treatments in
staterooms

Number of vaccinations
Number of persons detained by quar-
antine and immigration authorities
*Number of deaths

*The deaths aboard steamships of the New Orleans Division were caused by: heart failure, induced by excessive alcoholism, 1;
chronic myocarditis and acute alcoholism, 1; homicide by cutting or piercing instruments, 1.

Aban- garez	Atenas	Car- tago	Cas- tilla	Coppe- name	Here- dia	Irtona	Paris- mina	Sara- macca	Suri- name	Tela	Tur- rialba	Grand Total
17	17	17	18	19	18	14	17	20	19	13	18	207
337	336	349	293	367	359	218	362	372	362	196	358	3,909
1,012	1,012	1,057	750	773	1,109	580	1,036	834	784	510	1,062	10,519
138	145	210	209	183	255	146	226	187	129	47	146	2,021
1,008	1,016	1,037	734	790	1,114	575	1,040	835	794	455	1,069	10,467
7	9	11	12	5	8	16	9	7	4	13	7	108
—	—	4	—	1	—	—	—	—	—	—	1	6
2,219	2,384	2,163	716	826	2,523	523	2,345	1,074	1,050	238	2,503	18,564
361	423	207	10	287	280	7	235	289	297	9	403	2,808
522	469	229	448	529	449	237	546	374	495	352	629	5,279
764	725	352	607	644	542	368	945	517	708	603	865	7,640
32	76	41	77	87	37	47	90	16	54	56	92	705
130	119	72	51	72	71	23	116	47	81	8	149	939
159	96	82	60	78	93	26	153	66	107	13	165	1,098
152	112	56	53	27	26	10	80	29	69	16	63	693
207	126	154	130	126	15	129	75	106	126	69	196	1,459
6	6	6	8	4	7	7	4	39	3	3	11	104
—	—	—	1	1	—	—	—	—	—	—	1	3

CLASSIFICATION OF DISEASES TREATED ABOARD PASSENGER STEAMSHIPS AND BY PORT MEDICAL OFFICERS
AT NEW YORK, NEW ORLEANS AND BOSTON

	Steamships N. Y. Division		Steamships N. O. Division		Port Med. Officer New York		Port Med. Officer New Orleans		Port Med. Officer Boston		Revere Sugar Refinery Boston	
	Crew	Pass.	Crew	Pass.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
Endemic or infectious diseases (Charts Nos. 1 to 42, incl.)	174	50	145	39	41	1	17	2	8	—	—	—
General diseases not included above (Charts Nos. 43 to 69, incl.)	153	64	45	19	19	—	6	3	4	—	9	—
Diseases of the nervous system and or- gans of special sense (Charts Nos. 70 to 86, incl.)	215	109	200	46	96	—	46	2	42	—	62	—
Diseases of the circulatory system (Charts Nos. 87 to 96, incl.)	63	42	23	7	12	—	12	1	3	—	—	—
Diseases of the respiratory system (Charts Nos. 97 to 107, incl.)	335	110	492	77	81	—	46	—	16	—	56	—
Diseases of the digestive system (Charts Nos. 103 to 127, incl.)	527	261	2,458	369	100	—	77	4	25	—	114	—
Non-venereal diseases of the genito- urinary system and its adnexa (Charts Nos. 128 to 142, incl.)	34	22	20	13	15	—	4	1	5	—	—	—
The puerperal state (Charts Nos. 143 to 150, incl.)	—	4	—	—	—	—	—	—	—	—	—	—
Diseases of the skin or cellular tissue (Charts Nos. 151 to 154, incl.)	158	52	489	76	120	2	56	3	73	—	36	—
Diseases of the bones and organs of lo- comotion (Charts Nos. 155 to 158, incl.)	190	78	43	4	29	—	5	—	16	—	13	—
Malformations (Chart No. 159)	—	—	—	—	—	—	—	—	—	—	—	—
Diseases of early infancy (Chart Nos. 160 to 163, incl.)	—	1	—	—	—	—	—	—	—	—	—	—
Old age (Chart No. 164)	—	—	—	—	—	—	—	—	—	—	—	—
External causes (Charts Nos. 165 to 203, incl.)	1,178	185	773	63	718	16	508	6	408	—	2,402	—
Ill-defined diseases (Charts Nos. 204 and 205, incl.)	72	215	591	226	10	—	150	2	—	—	—	—
TOTAL	3,099	1,193	5,279	939	1,241	19	927	24	600	—	2,692	—

NOTE: This table gives only cases treated, and does not show the number of treatments.

There were no cases of quarantinable diseases aboard our steamships during the year. There were 3 cases of trachoma among the deck passengers; and 6 cases of venereal diseases among the passengers, and 124 cases among members of the crews.

The chart numbers used are taken from the "International List of Causes of Sickness and Death." These chart numbers are used universally by public-health and city and state health departments and organizations.

REPORT OF PORT MEDICAL OFFICERS AND SANITARY INSPECTOR

MEDICAL AND SURGICAL CASES TREATED

Port	Medical Cases		No. of Treatments	Surgical Cases		No. of Treatments	Total	
	No. of Cases Emp.	No. of Cases Non-Emp.		No. of Cases Emp.	No. of Cases Non-Emp.		No. of Cases	No. of Treatments
New York	290	1	377	951	18	3,202	1,260	3,579
New Orleans	353	10	450	574	14	1,841	951	2,291
Boston { Long Wharf	192	—	284	408	—	860	600	1,144
{ Revere Refinery	290	—	15	2,402	—	3,678	2,692	3,693
GRAND TOTAL	1,125	11	1,126	4,335	32	9,581	5,503	10,707

PHYSICAL EXAMINATION OF PROSPECTIVE EMPLOYEES

Port	Total No. Examined	Total No. Rejected	Per Cent Rejected
New York	863	187	21.67
New Orleans	523	74	14.15
Boston	295	27	9.15
TOTAL	1,681	288	17.13

PHYSICAL EXAMINATION OF MEMBERS OF CREWS

Port	Total No. Examined	Total No. Rejected	Per Cent Rejected
New York	13,268	268	2.02
New Orleans	11,167	119	1.07
Boston	3,271	13	.04
TOTAL	27,706	400	1.44

PHYSICAL CAUSES FOR REJECTION OF MEMBERS OF CREWS

	New York	New Orleans	Boston		New York	New Orleans	Boston
Malaria, clinical	—	1	—	Diseases of the lymphatic sys- tem	—	5	—
Dysentery, amebic	—	—	1	Pleurisy	—	1	—
Varicella	1	—	—	Diseases of the teeth and gums	9	—	—
Acute pulmonary tuberculosis	1	—	—	Other diseases of the buccal cav- ity and adnexa	—	1	—
Acute disseminated tuberculosis	1	—	—	Tonsilitis	7	—	—
Syphilis, primary	1	17	—	Appendicitis	1	—	—
Syphilis, secondary	1	2	—	Hernia	83	19	4
Syphilis, tertiary	3	1	—	Kidney removed	—	—	1
Syphilis, period not specified	8	—	1	Non-venereal diseases of the male genital organs	13	2	—
Soft chancre	28	12	1	Boils	2	—	—
Gonococcal infection except that of the eye or adnexa	64	55	5	Scabies	1	—	—
Benign tumor	1	—	—	Dhobie itch	1	—	—
Chronic rheumatism	1	—	—	Ulcer of the skin	1	—	—
Anemia	2	—	—				
Trachoma	3	1	—				

Other diseases of the eye or its adnexa	6	1	—	Other diseases of the skin and adnexa	24	1	—
Diseases of the ear	1	—	—	Other diseases of the bones or organs of locomotion	1	—	—
Hemorrhoids	2	—	—	Injury by cutting or piercing instruments	1	—	—
				TOTAL	268	119	13

VACCINATIONS

New York	57
New Orleans	892
Boston	21

FUMIGATION

	New York	New Orleans	Boston
Steamships fumigated throughout	41	43	19
Holds only	—	—	—
Superstructure only	—	—	1
Forward quarters	18	2	7
Aft quarters	12	1	14
Separate rooms	7	6	4

EXPLANATORY NOTES

A list of abbreviations as used in the following tables — with their meanings — is given herewith:

M.—Male

F.—Female

T.—White persons born in temperate zones

O.—All persons other than “white persons born in temperate zones”

Emp.—Employee

Non-emp.—Non-Employee

Pass.—Passenger

O.—Office Calls

V.—Visits

N. Y.—New York

N. O.—New Orleans

Referring to the names of certain divisions which do not indicate the name of the country where located, the following explanation is given: Banes and Preston Divisions are located in Cuba; and the Tela Railroad Division and the Truxillo Railroad Company in Honduras.

The chart numbers referred to in some of the tables are taken from the “International List of the Causes of Sickness and Death.” These chart numbers are used universally by public-health and city and state health departments and organizations.

The term “Employees” includes all persons appearing on our pay-rolls, including laborers and others employed on a part-time or hourly basis.

The term “Non-Employees” includes all persons formerly indicated by the classifications “Members of Families of Employees” and “Other Non-Employees” — i. e., all persons not included in the term “Employees.”

In the present Report it will be noted that a change has been made in the method of classifying persons dependent upon the Company for medical attention. In reports issued prior to 1924 the subdivisions were based upon races—white and colored. This classification has been discontinued in the present Report, and patients are separated into two groups — (1) White persons born in temperate zones, and (2) “Others” — the latter including all individuals, irrespective of color or race, except white people with nativity in temperate zones. This method will make possible, for those interested, a determination of the effects of climatic conditions on people born in temperate zones and residing in a tropical climate. Of course, the separate groupings of “employees” and “non-employees,” male and female, have been continued. It may be stated that the 1924, 1925 and 1926 Reports were compiled on the same basis as the present Report.

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